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TOTAL MASS EMISSIONS FROM A HAZARDOUS WASTE INCINERATOR

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Past studies of hazardous waste incinerators by the Hazardous Waste Engineering Research Laboratory have primarily examined the performance of combustion systems relative to the destruction and removal efficiency (DRE) for Resource Conservation and Recovery Act (RCRA) Appendix VIII compounds in the waste feed. These earlier studies demonstrated that in general most facilities performed quite well relative to the DRE. However, subsequent review by the Environmental Protection Agency's (EPA) Science Advisory Board raised questions about additional Appendix VIII or non-Appendix VIII constituents that were not identified in the earlier tests and might be emitted from hazardous waste combustion. This report presents results of a characterizstion of incinerator effluents to the extent that the emitted compounds can be identified and quantified. Measurements were made of both Appendix VIII and non-Appendix VIII compounds in all effluents (stack, ash, water, etc.) from a full scale incinerator. A broad array of sampling and analysis techniques were used. Sampling methods included Modified Method 5, volatile organic sampling train (VOST), and specific techniques for compounds such as formaldehyde. Analysis techniques included gas chromatography (GC) and gas chromatography/mass spectrometry (GC/MS). Continuous measurements were also made for a variety of compounds including total hydrocarbons by flame ionization detection (FID).

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FOREWORD

Today's rapidly developing and changing technologies and industrial products and practices frequently carry with them the increased generation of solid and hazardous wastes. These materials, if improperly dealt with, can threaten both public health and the environment. Abandoned waste sites and accidental releases of toxic and hazardous substances to the environment also have important environmental and public health implications. The Hazardous Waste Engineering Research Laboratory assists in providing an authoritative and defensible engineering basis for assessing and solving these problems. Its products support the policies, programs and regulations of the Environmental Protection Agency, the permitting and other responsibilities of State and local governments and the needs of both large and small businesses in handling their wastes responsibly and economically.

This report describes the results of a Total Mass Emissions (TME) field test conducted on a hazardous waste incinerator. The incinerator was operated under steady state as well as induced upset conditions with the products of combustion being sampled and analyzed. This type of data will help in the understanding and possible regulation of the products of incomplete combustion that result from the incineration of hazardous waste. For further information, please contact the Alternative Technology Division of the Hazardous Waste Engineering Research Laboratory.

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Abstract

Past studies of hazardous waste incinerators by the Hazardous Waste Engineering Research Laboratory have primarily examined the performance of combustion systems relative to the destruction and removal efficiency (DRE) for Resource Conservation and Recovery Act (RCRA) Appendix VIII compounds in the waste feed. These earlier studies demonstrated that in general most facilities performed quite well relative to the DRE. However, subsequent review by the Environmental Protection Agency's (EPA) Science Advisory Board raised questions about additional Appendix VIII or non-Appendix VIII constituents that were not identified in the earlier tests and might be emitted from hazardous waste combustion. This report presents results of a characterization of incinerator effluents to the extent that the emitted compounds can be identified and quantified. Measurements were made of both Appendix VIII and non-Appendix VIII compounds in all effluents (stack, ash, water, etc.) from a full scale incinerator. A broad array of sampling and analysis techniques were used. Sampling methods included Modified Method 5, volatile organic sampling train (VOST), and specific techniques for compounds such as formaldehyde. Analysis techniques included gas chromatography (GC) and gas chromatography/mass spectrometry (GC/MS). Continuous measurements were also made for a variety of compounds including total hydrocarbons by flame ionization detection (FID).

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SECTION 1.0

INTRODUCTION

The Resource Conservation and Recovery Act (RCRA) was enacted in 1976 and amended in 1984 by Hazardous and Solid Waste Amendments (HSWA) to handle the present day problems of toxic and hazardous waste disposal. Commensurate with these statutes, the Environmental Protection Agency (EPA) regards incineration as one of the principal technology candidates for the ultimate safe disposal of wastes and promulgated the following standards in the Federal Register, Volume 46, No. 15, on January 23, 1981.

1. An incinerator must achieve a destruction and removal efficiency (DRE) of 99.99% for each principal organic hazardous constituent (POHC) designated for each waste feed.

2. An incinerator burning hazardous waste must not emit more than 1.8 kg/hr of hydrogen chloride (HCl) or must remove 99% of the hydrogen chloride from the exhaust gas.

3. An incinerator burning hazardous waste must not emit particulate matter exceeding 180 milligrams per dry standard cubic meter (mg/dscm).

Commensurate with the regulation of hazardous waste incinerators, the EPA's Hazardous Waste Engineering Research Laboratory (HWERL) has the responsibility to provide information on the ability of these combustion systems to dispose of hazardous wastes in a manner that provides adequate protection of the public health and welfare. Past HWERL studies in this area have primarily examined the performance of combustion systems relative to the DRE for RCRA Appendix VIII compounds in the waste feed.

These earlier studies demonstrated that in general most facilities performed quite well relative to the DRE. However, the studies themselves and subsequent review of these studies by EPA's Science Advisory Board (SAB) raised additional questions about the performance of hazardous waste incinerators. In their final report, the SAB stated that "Incineration is a valuable and potentially safe means for disposing of hazardous chemicals...," but also came to the following conclusion:

> "This approach (DRE for selected POHC) emphasizes the compounds in the waste and does not fully address either partial oxidation or chemical recombinations which may create new toxic compounds."

The SAB also commented on the lack of information on the total emissions (identification of toxic species and quantification of emission rates) from combustion of hazardous wastes, particularly under conditions of less than optimal performance. One major issue that surfaced was the question of what additional Appendix VIII or non-Appendix VIII constituents that were not identified in the earlier tests might be emitted from hazardous waste combustion.

To address these issues, the EPA initiated this project to qualitatively and quantitatively study the characteristics of all possible effluents, under both steady-state and transient operating conditions. For a project of this nature, a number of caveats must be considered to properly interpret the results of the study. First, the study attempted to analyze complex mixtures of numerous chemicals within specific resource limits. The results of this study, therefore, will not identify 100% of the quantity of chemicals emitted; to do so would be very costly, if even possible. The analyses were targeted towards those compounds anticipated to be present based upon the nature and characteristics of the waste feed materials and based on data from previous studies. This study did not specifically address the formation or emission of either dioxins (PCDDs) or furans (PCDFs). These compounds have been studied during numerous other combustion programs and were not included in the overall scope of this program. Second, this study was conducted at a single incineration facility. Even though this facility contained a number of the design features and operating conditions commonly associated with other incinerators, the results of the study are only representative of this site. No information is provided for any variations in the results that may be expected between sites. Third, the study was conducted for research and was not directed towards the attainment of an operating permit. As such, some of the sampling procedures and analytical techniques are not the same as those normally associated with trial burns for permit applications.

The remainder of this report is divided into four sections. Section 2 is a brief summary of the conclusions derived from this study. Section 3 presents a description of the program including the program objectives, site selection procedure, incineration process description, and sampling and analysis procedures. A discussion of the results of this study is provided in Section 4. Section 5 gives the references cited in this report. Two appendices contain additional information as follows: Appendix A presents a detailed discussion of the sampling and analysis methods used in the study; and Appendix B provides the experimental data from the study.

SECTION 2.0

CONCLUSIONS

The conclusions listed below are based on results obtained from tests at one incineration facility burning one mix of hazardous waste. The facility was reasonably representative of a larger, well operated incinerator; however, previous tests at hazardous waste incinerators have shown that the specific compounds emitted and their levels in stack gases can vary considerably. The conclusions should be viewed in this context.

1. The percent of the total hydrocarbon (THC) emissions that were detected as specific compounds ranged from 50 to 67% for five of the six test runs; 91% was detected in one run. During the study, a very large number of constituents were separated by the analytical methods. However, a much smaller number could be specifically identified from the computer MS library search and manual interpretation. Thus, many of the detected organic compounds could be identified only by class. The fraction of the THC that was not detected is most likely explained by uncertainty in the measurements, compounds that were not chromatographable by the analytical conditions, or the GC columns used would not effectively separate the compounds.

2. Methane accounted for the largest fraction of the THC.

3. Oxygenated aliphatic compounds were the largest class of compounds among the semivolatiles, both in total mass and number of compounds.

4. The transient upsets during Runs 4 to 6 did not cause significant increases in the concentrations of semivolatile compounds or most volatile compounds. The three volatile compounds that did increase were methane, methylene chloride, and benzene. Methane increased the most dramatically.

5. Particulate and HCl emissions were low and did not change between the steady state and transient test runs.

SECTION 3.0

PROGRAM DESCRIPTION

This section presents the program objectives, site selection procedures, an overview of the incinerator and the incineration process, and a discussion of the sampling and analysis procedures employed for the study.

3.1 PROGRAM OBJECTIVES

The primary overall objective of this study was to conduct an inventory of a hazardous waste incinerator in which the total mass emissions (TME) were measured and quantified to the extent possible within the program resources. As a part of this objective, numerous sampling and analysis (S&A) techniques were employed to identify and quantify the constituents in each of the waste streams. In addition, a second objective was to study the emissions under two sets of operating conditions: steady state and steady state with induced transient combustion upsets. The steady state operation was similar to conditions during a trial burn, and the induced transient upsets were intended to simulate conditions that could occur at times during the normal operation of an incinerator.

3.2 SITE SELECTION

It was desirable in the selection of an incinerator for this program to select a site that would be most representative of hazardous waste incinerators in the United States. Although it is impossible to be completely representative at any single site, the chosen site had many of the equipment components common to hazardous waste incinerators and the capability to burn a wide variety of types of wastes. The initial step in the selection process was the development of the incinerator site selection criteria. In developing these criteria, the following issues related to the program objectives were addressed:

- The facility must have effluent streams that can be analyzed to determine type and extent of emissions for use in the TME analysis.
- The facility must be capable of accepting a variety of wastes including both solid and liquid feed streams.
- The facility must have a wide operating range which can be varied as part of normal operation.

Criteria were developed for each of the following areas:

- Incinerator type
- Air pollution control system
- Waste feed characteristics and variability
- Operating flexibility
- Sampling locations

Table 3-1 summarizes the selection criteria under each of these areas and classifies them as either required criteria or as desirable criteria.

Subsequent to the formulation of the selection criteria, information from a variety of sources was used to compile a list of facilities which met the required criteria. This list was ordered from most desirable to least desirable and the facilities were contacted to determine their willingness to participate in this program. The principal sources of information used to develop the list of sites for this program were:

TABLE 3-1. SUMMARY OF SITE SELECTION CRITERIA

	Required	Desirable
Incinerator type	Rotary kiln (semicontinuous feed) Secondary combustion chamber or afterburner Organic liquid feed	Aqueous liquid feed Sludge feed Dry ash collection system
Air pollution control system	Wet scrubber for HCl Particulate control device	Venturi scrubber Once through water
Feed characteristics	Amenable to spiking Volatile organic solids (e.g., paint wastes) Large storage capacity	Variety of chlorinated organics
Operating and control flexibility	Wide range of operating conditions Willingness to vary conditions	
Sampling location	Access to all effluent streams Adequate stack sampling ports and platform Space for mobile van and trailer	

- MITRE Hazardous Waste Control Technology Data Base compiled in 1982
- A 1981 survey of incinerators for Regulatory Impact Analysis
- Part A permit applicants as listed in the Hazardous Waste Data Management System
- Facilities with whom MRI has worked in the past

These sources were used to compile a list of 17 facilities which met the selection criteria and might be willing to participate in this program. The 17 sites were contacted to determine the following information:

- If the facility was currently burning solid and liquid hazardous wastes on a regular basis
- Their degree of willingness to cooperate in the study
- Available data on the incinerator system

From the 17 facilities which were originally identified as potential sites for the study, the list was narrowed to three sites as most desirable and three alternate facilities. During subsequent discussions with these facilities, one site became the most obvious choice. A site visit was conducted at the Dow Chemical plant at Plaquemine, Louisiana, and, based on the results of that visit, the facility was chosen as the site to conduct this study.

3.3 PROCESS DESCRIPTION

This section presents a description of the rotary kiln incinerator facility used in the study, the incinerator operating parameters, types of wastes employed, and the characteristics of each of the wastes.

3.3.1 Incinerator Description

The Environmental Operations Rotary Kiln Incinerator System that is operated at Dow's Plaquemine, Louisiana, plant is shown schematically in Figure 3-1. The facility processes a wide variety of hazardous waste streams from the Dow facility as well as plant refuse and discarded commercial products that are nonhazardous.

As shown in Figure 3-1, the system comprises two chambers. The primary chamber is a rotary kiln. The kiln can receive solid waste feeds via a ram feed system at the front end of the kiln, slurry feed at the side of the kiln near the front end, and liquid organic/aqueous waste feeds through two liquid injection units in the front end. The slurry feed was not used in this study. Kiln ash drops down into a water bath (sump) and is conveyed up an inclined conveyor and dropped into the ash hopper. Blowdown from the sump goes to the NPDES discharge. The primary combustion gases exit the end of the kiln and are directed upward through the secondary chamber. The secondary chamber contains two liquid injection nozzles that are used to fire high heating value liquid organic waste.

Stack gases leaving the secondary chamber pass through a vertical quench section and three-stage ionizing wet scrubber before being exhausted to the atmosphere. The ionizing wet scrubber (IWS) thus serves for both particulate and acid gas removal. Caustic flow rate to the unit is such that a pH of approximately 6.5 to 7.0 is maintained. Effluents from the quench and all three scrubber cells are combined, flowing to an NPDES discharge. Makeup process water is added to both the quench chamber and IWS cells to maintain steady-state conditions.

The plant was well equipped for sampling all influent and effluent streams. The solid waste feeds are containerized and were sampled in a staging area. The two liquid feed systems on the front of the kiln are equipped to receive wastes from different waste feed lines. Both had sample taps on the fixed piping immediately upstream from the incinerator.

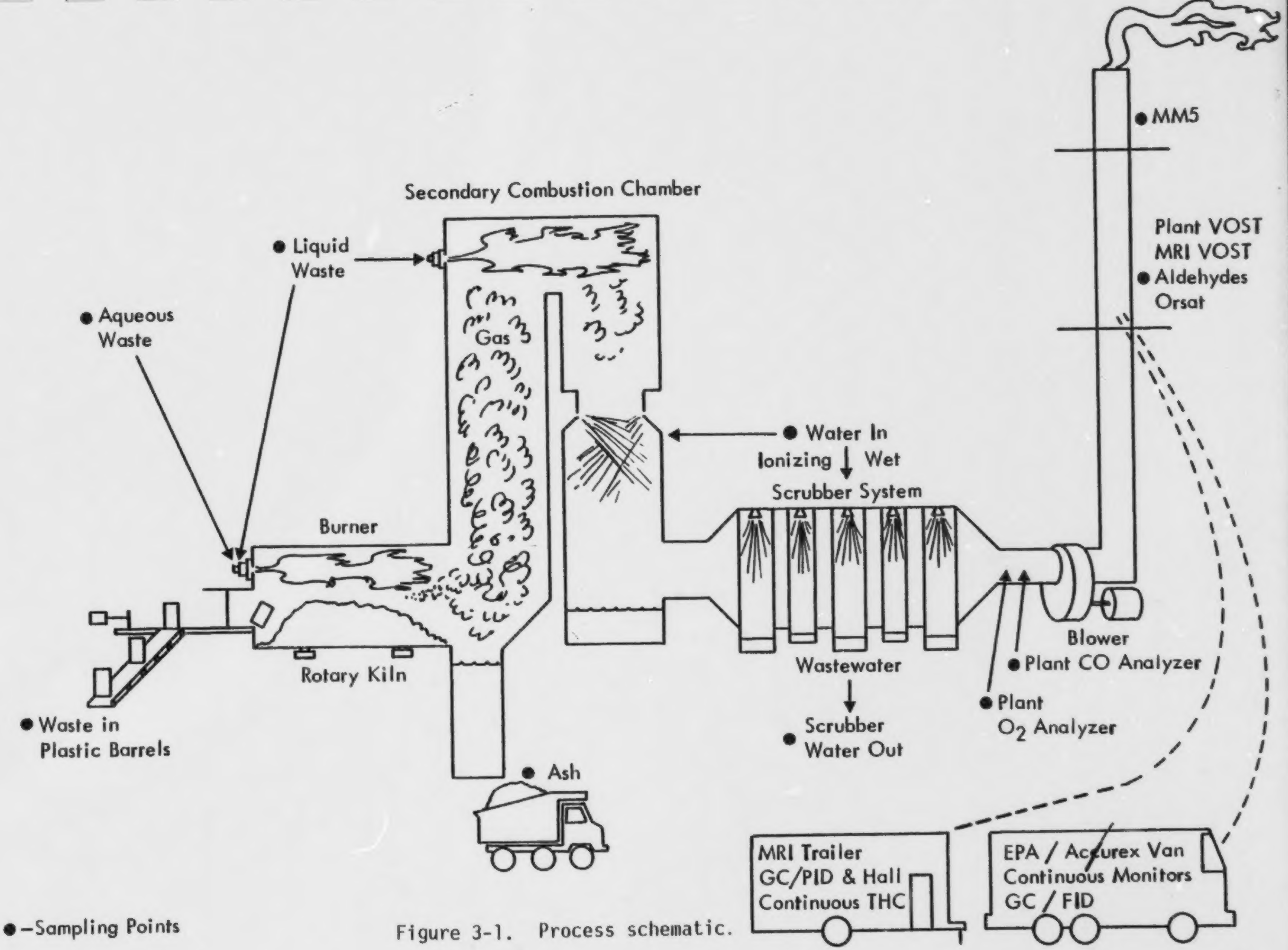
Secondary Combustion Chamber
● Liquid Waste
● Aqueous Waste
Gas
Burner
Rotary Kiln
● Waste in Plastic Barrels
● Ash
● Water In
Ionizing Wet
Scrubber System
Wastewater
● Scrubber Water Out
● MM5
Plant VOST
MRI VOST
● Aldehydes
Orsat
Blower
● Plant CO Analyzer
● Plant O_2 Analyzer
MRI Trailer
GC/PID & Hall
Continuous THC
EPA / Acurex Van
Continuous Monitors
GC / FID
●–Sampling Points

Figure 3-1. Process schematic.

The kiln ash samples were taken as the wet ash dropped into the hopper. The combined scrubber liquid effluents were taken from a tap in the discharge line located at the edge of the incinerator block.

The 48-in. ID combustion stack was constructed of fiberglass and equipped with two sets of two 3-in. ports located at 90-degree angles. One set of ports is located about 25 ft above the ground and the other about 50 ft above the ground. Preliminary testing showed that the stack flow was not cyclonic.

3.3.2 Process Operation

3.3.2.1 Normal Process Operating Parameters--

A summary of several key incinerator operating parameters for each test run is provided in Table 3-2 and a summary of the emission control device operating parameters is provided in Table 3-3.

Combustion temperatures in the rotary kiln are normally maintained at about 1500°F (800°C), while the secondary combustion chamber typically operates around 1800°F (980°C). As the heating value and feedrate of the waste varies, temperature in both chambers is maintained by modulating combustion of natural gas.

Combustion gas flow rate during the testing averaged around 22,000 acfm. Values remained fairly consistent from run-to-run, ranging from 20,100 to 21,800 acfm (Runs 1-3). Transient values (Runs 4-6) were somewhat higher, ranging from 23,400 to 24,900 acfm.

Pressure within the combustion chamber is normally around 0.30 to 0.35 in. of water of draft (vacuum). The secondary combustion chamber typically operates at around 0.05 in. of vacuum. Neither location exhibited any significant variations during the tests.

Oxygen concentration in the stack is normally within the 10 to 13% range. During testing, oxygen levels were consistently around 10 to 11.5%.

TABLE 3-2. SUMMARY OF KEY PROCESS PARAMETERS

Parameter	Average value, run No.					
	1	2	3	4	5	6
Total methane mass flow, lb/hr	372	414	423	552	615	532[a]
Kiln temperature, °F (°C)	1550 (843)	1386 (752)	1438 (781)	1440 (782)	1364 (740)	1467 (797)
SCC[b] temperature, °F (°C)	1857 (1014)	1738 (948)	1708 (931)	1776 (969)	1782 (972)	1852 (1011)
Stack gas temperature, °F (°C)	163 (73)	160 (71)	154 (68)	160 (71)	165 (74)	167 (75)[a]
Stack gas flow rate, acfm x 10^{-3}	21.8	20.1	21.2	23.4	24.9	23.4
Oxygen (% O_2) in stack	10.1	11.1	11.5	11.2	10.6	9.9
Kiln vacuum, in. H_2O	-0.34	-0.33	-0.30	-0.35	-0.35	-0.35[a]
SCC vacuum, in. H_2O	-0.05	-0.05	-0.05	-0.04	-0.04	-0.04
Atomization steam pressure (kiln), psig	25.0	25.0	25.5	25.0	25.0	25.0
Atomization steam pressure (SCC), psig	50.0	50.0	50.0	50.0	50.0	50.0

[a] Dow Incinerator Control Center data logger was inoperable for the first 110 min of the run. Average values based on last 65 min of the run.

[b] SCC = Secondary Combustion Chamber.

TABLE 3-3. SUMMARY OF EMISSION CONTROL OPERATING PARAMETERS

Parameter	Average value, run No.					
	1	2	3	4	5	6
Quench temperature, °F (°C)	174 (79)	172 (78)	171 (77)	172 (78)	176 (80)	180 (82)
Quench water flow rate, gpm	225	241	255	245	236	222
Sump pH	2.9	4.7	3.9	2.9	3.1	2.9
Cell No. 2 pH	6.2	6.0	6.5	6.5	7.0	6.1
Scrubber outlet pH	6.3	6.7	6.8	6.7	7.5	7.1
Prescrubber water flow rate, gpm	84.9	85.1	85.0	85.1	85.1	84.8
2nd Scrubber water flow rate, gpm	37.5	37.5	37.5	37.5	37.5	37.5
3rd Scrubber water flow rate, gpm	37.5	37.5	37.6	37.5	37.5	37.5[a]

[a] Dow Incinerator Control Center data logger was inoperable for the first 110 min of the run. Average values based on last 65 min of the run.

Atomization steam pressure was maintained at 25 psig for the kiln and 50 psig for the SCC. Little variation was observed while testing.

3.3.2.2 Induced Transient Conditions--

Process upset conditions can often be detected by monitoring of carbon monoxide (CO) levels. High CO levels indicate poorer combustion efficiency.

The best technique identified at the Dow facility to simulate incinerator upset conditions was by manipulation of the fuel rates and measurement of the resultant carbon monoxide (CO) levels. Initially, induced upsets were attempted in the rotary kiln by spiking the solid waste drums with volatile hydrocarbons (e.g., 5-gal. diesel fuel plus 5-gal. xylene). This procedure did not result in any significant rapid elevation in the CO levels. Next, momentarily step-changing the liquid organic waste feedrate to the kiln from 2 to 6 gal/min was performed. Only small sudden increases in CO levels were observed and these changes were difficult to reproduce. Finally, step-changing the liquid organic waste feedrate to the secondary combustion chamber from 2 to 6 gal/min for 7 sec was tried. This procedure produced the desired, reproducible rapid elevations in CO levels and subsequently was utilized in Runs 4, 5, and 6.

3.3.3 Waste Feed Characteristics

Three types of solid waste feeds were used during all of the runs; a substituted cellulose, polyethylene wax, and chlorinated pyridine tars. Each of the solid wastes were individually contained in plastic drums with a metal rim ring. One drum of solid waste was fed every 4 min with the drums of each type of waste being alternately fed through a ram feeder into the kiln.

Liquid waste feeds were of either organic or aqueous composition. Prior to testing, a uniform supply of the liquid organic waste, sufficient for about 100 hr of incinerator operation, was accumulated in a 15,000-gal. capacity tank. The liquid organic waste feed was spiked so as to achieve a mixture of about 10% carbon tetrachloride, with the remainder being primarily Isopar (C5-C8 saturated hydrocarbons). During the tests, the storage tank was continuously agitated to insure uniform sample composition. Aqueous waste feeds were obtained from runoff at the plant site, and mainly consisted of water with a variety of organic compounds present.

Table 3-4 lists the average feedrate, higher heating value, percent chlorine, and percent ash for each of the three types of waste during the three steady state runs and the three transient runs. The viscosity of the liquid organic waste feed also is given in Table 3-4. The brief intermittant increases in the liquid organic feedrate, used in Run 4, 5, and 6 to produce CO spikes, were of very short duration and did not impact the average feedrate.

3.4 SAMPLING AND ANALYSIS PROCEDURES

This section provides general descriptions of the sampling and analysis methods employed for this study. A summary of the sampling and analysis parameters and methods employed is shown in Table 3-5. The sampling methods, field measurement methods, and analytical methods are presented in detail in Appendices A and B.

3.4.1 Sampling Methods

3.4.1.1 Liquid Waste Feed--

Liquid organic and aqueous waste feed sampling was performed just upstream of injection to the rotary kiln (primary combustion chamber). For both organic and aqueous wastes, one sample was taken every 15 min, which was composited into an organic waste sample and an aqueous waste sample for each run. Following the test, a VOA vial was filled from each composite sample. Aqueous waste VOA grab samples were also taken every 15 min during the test at the same time as composite grabs were taken.

3.4.1.2 Solid Waste Feed--

Composite samples of each of the three types of solid waste feed (substituted cellulose, polyethylene wax, and chlorinated pyridine tar) were obtained prior to testing. Fifteen drums of each type were set aside and specifically marked for each run.

TABLE 3-4. AVERAGE WASTE CHARACTERISTICS

	Feedrates (lb/h) steady state/ transient	HHV[a] (Btu/lb) steady state/ transient	Cl (%) steady state/ transient	Ash (%) steady state/ transient	Saybolt viscosity (s)
Solid					
Chlorinated pyridine	1,300/1,352	1,966/1,701	26.41/20.75	35.13/37.59	-
Polyethylene wax	513/473	15,243/17,097	0.016/0.010	0.16/0.087	-
Substituted cellulose	1,115/1,230	6,983/6,250	0.39/0.61	4.08/2.95	-
Liquid organic					
To kiln	520/493	18,034/17,983	10.68/10.80	0.033/0.026	39.5/39.2
To SCC	821/821	18,034/17,983	10.68/10.80	0.033/0.026	39.5/39.2
Liquid aqueous	5,007/4,940	15/0	0.0044/0.0023	0.031/0.034	-

[a] HHV = higher heating value.

TABLE 3-5. SUMMARY OF SAMPLING AND ANALYSIS PARAMETERS AND METHODS

Sample	Sampling frequency for each run	Sampling method	Sample size	Analytical parameters	Preparation method[a]	Analytical method[a]
Liquid organic waste	One grab sample every 15 min composited into one sample for each run	Tap (S004)	1 L	SV POHCs[b]	Sample dilution	GC/MS[c]
				Chlorides	NA	Organic halide (D4327-84 or D808-81)[j]
				Heating value	NA	Calorimeter (D240-73)
				Ash	NA	Ignition (D482-80)
				Viscosity	NA	Viscometer (D-88-81)
	Once at end of run	VOA vial[d] filled from composite	40 mL	V POHC[e]	Purge and trap	GC/MS
Aqueous waste	One grab sample every 15 min composited into one sample for each run	Tap (S004)	4 L	SV POHC[b]	Solvent extraction	GC/MS
				Chlorides	NA	Organic halide (D4327-84 or D808-81)
				Heating value	NA	Calorimeter (D240-73)
				Ash	NA	Ignition (D482-80)
	One VOA vial every 15 min	Tap (S004)	40 mL per vial	V POHC	Purge and trap	GC/MS
Solid waste	One grab sample per solid charge, composited at end of test	Scoop (S007)	≃ 250 g per grab	V POHC	Tetraglyme dispersion/purge and trap	GC/MS
				SV POHC	Solvent extraction	GC/MS
				Chlorides	NA	Organic halide (D4327-84)
				Heating value	NA	Calorimeter (D2015-77)
				Ash	NA	Ignition (D482-80)
Scrubber water inlet	One grab sample every 30 min composited into one sample each run	Dipper (S002)	4 L	SV POHC	Solvent extraction	GC/MS
	One VOA vial every 30 min	VOA vial filled from grab sample	40 mL/VOA	V POHC	Purge and trap	GC/MS
Scrubber water outlet	One grab sample every 30 min composited into one sample each run	Dipper (S002)	4 L	SV POHC	Solvent extraction	GC/MS
	One VOA vial every 30 min	VOA vial filled from grab sample	40 mL/VOA	V POHC	Purge and trap	GC/MS

(continued)

TABLE 3-5 (continued)

Sample	Sampling frequency for each run	Sampling method	Sample size	Analytical parameters	Preparation method[a]	Analytical method[a]
Ash	One grab sample per run	Scoop (S007)	500 g	SV POHC	Solvent extraction	GC/MS
Stack gas	2-hr composite per run	MM5[f]	~ 60-100 ft^3[g]	Particulate	Desiccation	Gravimetric (EPA RM5)
				HCl	NA	Colorimetric (EPA 325.2)
				Moisture	NA	Gravimetric
				Temperature	NA	Thermocouple
				Velocity	NA	Pitot tube
	2-hr composite per run	MM5	60-100 ft^3[g]	SV POHC	Solvent extraction	GC/MS
				Moisture	NA	Gravimetric
				Temperature	NA	Thermocouple
				Velocity	NA	Pitot tube
	Three trap pairs at 40 min per pair per run	VOST (S012)[h]	20 L per trap pair	Method 624 compounds	Purge and trap	GC/MS
	One composite sample per run	EPA Reference Method 3	≃ 20 L	Oxygen, carbon dioxide	NA	Orsat
	One composite sample per run	Midget impinger	~ 100 L	Aldehydes	NA	HPLC
	1 min averages	Continuous	NA	CO, CO_2	NA	NDIR
	1 min averages	Continuous	NA	O_2	NA	Paramagnetic
	1 min averages	Continuous	NA	NO_x	NA	Chemiluminescent
	1 min averages	Continuous	NA	THC	NA	FID
	~ once/5 min	Gas sampling valve	NA	THC	NA	GC/FID
	~ once/30 min[i]	Gas sampling valve	NA	C_1 to C_3 hydrocarbons	NA	GC/FID
	~ once/30 min[i]	Gas sampling valve	NA	Aromatics	NA	GC/PID

(continued)

TABLE 3-5 (continued)

Sample	Sampling frequency for each run	Sampling method	Sample size	Analytical parameters	Preparation method[a]	Analytical method[a]
Stack gas (cont.)	~ once/30 min[i]	Gas sampling valve or syringe	NA	Halogenated organics	NA	GC/Hall or PID

Note: Sampling method numbers (e.g., S004) refer to methods published in "Sampling and Analysis Methods for Hazardous Waste Combustion," December 1983; analytical methods beginning with prefix D and E refer to ASTM methods.

[a] Sample preparation and analytical methods are described in detail in Appendix A referencing the A. D. Little, EPA 600, and SW-846 methods.

[b] Semivolatile principal organic hazardous constituents.

[c] Gas chromatography/mass spectroscopy.

[d] Volatile organic analysis vial.

[e] Volatile principal organic hazardous constituents.

[f] MM5 = Modified Method 5.

[g] Exact volume of gas sampled will be dependent on isokinetic sampling rate.

[h] VOST = Volatile organic sampling train.

[i] Maximum rate permitted by analysis time.

All 15 of the chlorinated pyridine tar drums were sampled for each run's composite. Composites for the substituted cellulose and polyethylene wax were formed from sampling every third drum.

A separate group of individually sampled drums was established to allow for contingency should the need for additional solid waste feed arise during a test. This group consisted of 30 drums of each type, all of which were sampled individually. Whenever it became necessary to use any of these additional drums during a test, a portion of the individual sample was added to the composite for the original 15 drums of that type for the run. After all testing was completed, unused individual samples were returned to the plant for disposal.

Physical sampling of the solid waste involved opening each drum, scraping aside the top layer/film/adsorbent present, and removing a sample. A hand-held metal trowel was used for sample removal, and scraping of the sample into a collection jar additionally required use of wooden tongue depressors. After each individual use, tongue depressors were discarded.

3.4.1.3 Ash--

Ash sampling was performed at the end of each run. A grab sample was taken from the ash hopper using a metal scoop. Larger chunks were avoided due to physical size restrictions.

3.4.1.4 Flue Gas by Modified Method 5--

MRI used two identical MM5 sampling trains. The trains included nickel nozzles, Pyrex probe liners, Pyrex/Teflon filter holder, condensor and XAD cartridge, Ace Glass® threaded greaseless joints with an added impinger containing 0.1M sodium carbonate to ensure collection of HCl. To recover samples, the trains were rinsed with acetone followed by hexane. After reviewing each test run, one train was analyzed for particulates and the other was analyzed for semivolatile organics. If minor problems occurred during the test (e.g., small glass fragments collected on the filter), the alternate train was used for semivolatiles. A small aliquot of the impinger condensate as well as the alkaline impinger contents were analyzed for chlorides and any other anions observable using ion chromatography.

3.4.1.5 Flue Gas by VOST--

MRI collected three 40 min pairs of VOST traps during each run using an MRI-designed third generation train which uses compression loaded 0.625 in. Pyrex tubes and Cajon Ultra-Torr end fittings of the same diameter. One pair of field blanks (opened on stack for duration similar to the sample trap handling necessary to install and remove from the train) traps were also collected for each run. Unopened trip blanks were also used.

Simultaneous VOST sampling was also conducted by Dow using a Nutech-style sampling train. VOST samples were also collected by Acurex from the EPA analyzer van gas stream.

3.4.1.6 Flue Gas for Aldehydes--

MRI used a midget impinger train with 2,4-dinitrophenylhydrazine (DNPH) to collect aldehydes, especially formaldehyde. The samples were later analyzed by liquid chromatography according to EPA Method A132 (see Sections 4.1.3, 4.2.3, and Appendix B).

3.4.2 Continuous Emission Monitoring Methods

3.4.2.1 Total Hydrocarbons--

A Beckman 402 total hydrocarbon (THC) analyzer was used to continuously measure the THC content of the stack gas. The collection and transportation system maintained the gas stream at a minimum temperature of 120°C to prevent condensation losses. This temperature was well above that of the stack gas. The data were recorded on a strip chart recorder with manual 1-min average readings. The calibration gas was 10.2 ppm propane in air with a later comparison to a methane standard for determining methane equivalent response.

Dow also had a THC process analyzer connected to the stack which used an unheated sampling line. Both analyzers use a flame ionization detector (FID).

3.4.2.2 Carbon Monoxide--

Acurex and Dow both operated nondispersive infrared (NDIR) instruments to measure carbon monoxide similar to the continuous option in EPA Method 10. Data were logged at least once every minute by both instruments.

3.4.2.3 Other Gases--

Acurex also operated continuous gas analyzers for oxygen, carbon dioxide, and nitrogen oxides from the EPA monitoring van. Data were averaged at 30 sec intervals. MRI also collected an integrated gas bag sample for use in measuring O_2 and CO_2 by Orsat analysis.

3.4.3 Field Measurements by Gas Chromatography

3.4.3.1 Photoionization Detector--

MRI operated an on-site GC with a HNU photoionization detector (PID) with 10.2 ev lamp to measure aromatic compounds as well as certain unsaturated organics of interest such as vinyl chloride. The separation column used was a J&W 30 m DB-624 megabore column in a temperature programmed oven. The instrument was fitted with a heated Carle gas sampling valve with matched 1 mL gas sampling loops. The sampling valve was connected to the pressurized exit of the THC analyzer pump via a 20 ft section of unheated Teflon tubing. A water knockout trap was used to remove moisture from the gas stream.

3.4.3.2 Hall Detector--

MRI also operated an on-site GC fitted with a Tracor Hall detector. A 1% SP-1000 on Carbopack B column (same as used in EPA Method 624) was operated in temperature programmed mode to separate the purgeable halogenated organics. Calibration samples were injected directly into system. Samples were taken by gas-tight syringe from a septum port installed after the water knockout trap in the Teflon line which supplied gas to the field PID chromatograph.

3.4.3.3 Light Hydrocarbons--

Acurex operated an on-site GC with FID for measurement of light hydrocarbons. A Porapak QS column operated isothermally was used to separate the methane through propane series of hydrocarbons. Samples of stack gas were injected by gas-tight syringe. The samples were taken from a gas conditioning system located in the EPA Mobile Laboratory.

The field GC instruments were included to measure compounds such as methane and methyl chloride. The purpose of the methane and methyl chloride data was to provide immediate information about any unusual conditions existing in the incinerator effluent. A second reason for use of the field GCs was to obtain independent data for comparison with the VOST procedure.

The choice of the Hall detector and PID was made in order to obtain a minimum detection level (about 10 ppb) for the volatile aromatic and halogenated organics commonly analyzed by EPA Method 624. Each detector has good selectivity and sensitivity for its respective target compounds. In combination they cover most of the Method 624 list with minimal uncertainty in identification since only a few of the compounds co-elute. The detectors' selectivity rejects most interfering compounds.

3.4.4 Laboratory Analysis Methods

3.4.4.1 Volatile Compounds by GC/MS--

Samples were shipped from the field on a near-daily basis. Samples were inventoried upon receipt and transferred to the cold room for storage until analysis. Transfers of samples were recorded on sample traceability sheets.

Analytical standards were prepared by the methods given in Appendix A. Stock solutions of the internal standard and surrogate compounds were prepared by the methods given in EPA Method 624. Stock solutions of mixed standards of the volatile analytes were purchased from Supelco®. The working standards were prepared by combining and diluting aliquots of the standards from Supelco® and aliquots of the internal standard and the surrogate compounds to obtain the required concentrations.

The VOST traps were analyzed by spiking each trap with internal standard and surrogates. The spiked VOST traps were thermally desorbed and the effluent compounds were collected on an intermediate trap which was subsequently flash desorbed onto the GC/MS system using the conditions given in Appendix A.

The aqueous samples were analyzed by spiking a 5-mL aliquot with internal standard and surrogates, then purging the sample with a stream of pure nitrogen. The effluent compounds were collected on an intermediate trap which was subsequently flash desorbed onto the GC/MS system using the conditions given in Appendix A.

Aliquots of the liquid organic waste samples were weighed into polyethylene glycol (2 g into 40 mL). Surrogate compounds were spiked into the solution. Twenty microliter aliquots of these solutions were measured into 5 mL of blank water and the solution was purged with nitrogen as above. The effluent compounds were collected on an intermediate trap which was subsequently flash desorbed onto the GC/MS system using the conditions given in Appendix A.

Analytes were quantitated from peak areas of the appropriate extracted ion chromatogram plots by an internal standard method. The area ratios of the analyte peaks to the internal standard were compared to the mean relative response factor for that analyte. The mean relative response factors were determined by analyzing three levels of quantitative standards. The equations used to calculate relative response factors and analyte concentrations are presented in Appendix A.

3.4.4.2 Semivolatile Compounds by GC/MS--

Standard mixture solutions for the semivolatile MM5 train analysis were prepared from pure compounds. The recovery internal standard consisted of d_{10}-anthracene, 1-fluoronaphthalene, pentafluorophenol, and 4,4'-dibromophenyl in a benzene solution. The samples were quantitated against the 4,4'-dibromophenyl; the peaks due to the other standards were obscured by sample peaks. The method internal standard mixture was d_8-naphthalene, d_{10}-phenanthrene, decafluorobiphenyl, 2-fluorophenol, and 2,4,6-tribromophenol in an isooctane solution.

The MM5 train filters and XAD resins were Soxhlet extracted in methylene chloride. The condensates and train rinses were separatory funnel extracted under acidic and basic conditions in methylene chloride. Prior to extraction method internal standard solution was spiked into one component from each MM5 train. After extraction the component samples from each MM5 train were combined and concentrated with a Kuderna-Danish apparatus. For the samples from Run Nos. 4, 5, 6, and 5 blank train, 20% of the sample was removed by pipette for submission to DOW for their analysis. All samples were then concentrated to a final volume of 1.0 mL. At each step of this procedure laboratory method blanks were obtained and later analyzed by GC/MS.

MM5 samples were analyzed by GC/MS. Instrument calibration and experimental conditions are discussed further in Appendix A. This analysis was performed using a 30 m DB-5 capillary GC column and temperature programming conditions sufficient to elute all EPA Method 625 priority pollutants. Analysis of the GC/MS data is discussed in Section 3.5.

3.5 DATA INTERPRETATION

This subsection describes the procedures employed for identifying non-target compounds. Considerations relevant to the interpretation of these data are illustrated with specific examples from this study.

3.5.1 General Interpretation

The field GC tables report only those compounds that were detected more than once and that were not present as system background. Any peak which occurred in all injections was considered a background peak or artifact.

The only compound which may require blank correction is methyl chloride. The Hall detector showed intermittent response for this compound in materials which should not have contained it. Chloromethane appeared in both audit cylinders, once in the daily standards and in most of the stack samples. If the audit cylinders are known to contain no chloromethane, up to 250 ng/L (110 ppb as methane) could be subtracted from the stack readings. The information available is insufficient to determine whether or not to blank correct this compound.

The VOST tables were also condensed to show only those compounds which were detected more than once and not system background peaks. All silicon derivatives were excluded due to the high probability of them coming from septa and GC column liquid phases used in the analytical equipment. The VOST results are also blank corrected by subtracting the average blank trap value for each compound.

The conversion factors from ng/L to ppb are the molecular weights (MW) divided by the mole volume at 20°C (24.1 L/mole), i.e.:

$$\text{ng/L} \times \frac{\text{MW}}{24.1} = \text{ppb}$$

The conversion factors from ppb to ppb as methane are based on the effective carbon number commonly used in estimating FID response factors as well as measured literature values. The factors reported are estimates based upon the following references:

W. A. Dietz, J. Gas Chromatogr., 5, 68 (1967).

Robert L. Grob, Modern Practice of Gas Chromatography, Wiley and Sons, New York, 1985, pp. 247-248.

Model 402 Hydrocarbon Analyzer, Beckman Instruments, Fullerton, CA, 1981, p. 13.

Andreatch, Anal. Chem., 32, 1021-1024 (1960).

Other references, such as W. J. Kirsten and R. G. G. Andren, J. Chromatogr., 8 (1962), 525-530, show somewhat different factors, but the differences are both equally higher and lower so that the net effect on the total methane equivalent response is small. Such factors are normally assumed to be accurate to within 20% (Grob).

3.5.2 Identification of VOST Unknowns

Reported compounds present in the VOST samples which are not EPA Method 624 priority pollutants includes compounds present in a VOST trap at levels greater than approximately 5 ng. This lower limit corresponds to inclusion of compounds with GC/MS peak areas approximately three times the background area.

Typically, unknown compounds are semiquantitated using a response factor of 1.0 relative to the internal standard's total ion current area. In this case, the total ion area of the internal standard d_6-benzene was not usable due to interferences from coeluting compounds. In order to be consistent with results obtained from total ion areas, the area of the primary ion of d_6-benzene, m/z 84, was used with a response factor of 2.0. The value of 2.0 was chosen because inspection of standard spectra indicated that the area of m/z 84 is approximately one-half the total d_6-benzene ion area.

Concentrations of VOST unknowns were corrected for contributions from compounds found in field, trip, and GC/MS system blanks.

The VOST unknowns were identified by interpretation of their electron impact mass spectra. A computer search of the NBS mass spectral library was performed for each unknown spectrum. The mass spectra and search results were evaluated manually by personnel experienced in mass spectral interpretation. Manual searches of the NBS library were sometimes made to confirm identifications. The computer search often gave obviously erroneous identifications and was therefore used with discretion. The computer search was frequently not reliable because the unknown spectrum was not that of a pure compound (i.e., coeluting compounds) or the unknown was a compound whose spectrum was not in the library. In addition, since the lowest mass scanned in this analysis was m/z 40 and volatile compounds often contain significant fragmentation below this, the spectra were sometimes missing ions deemed important by the computer search and were therefore erroneously identified. Acetone and dimethyl ether are examples of common compounds which were misidentified by the computer search.

Many of the VOST unknowns were aliphatic hydrocarbons. With the exception of isooctane, these compounds were not specifically identified by structure but only by chemical formula. Isomeric hydrocarbons often have similar mass spectra making exact structural identifications difficult. In cases where the mass spectrum contained only alkyl fragment ions and no molecular ion (suggesting a formula C_xH_y), the compound is referred to as "Hydrocarbon."

"CHO Compound" is used to denote an oxygenated aliphatic compound of formula $C_xH_yO_z$. In these cases, the mass spectra have characteristic oxygenated ions such as $C_2H_5O^+$ (m/z 45) or $C_3H_7O^+$ (m/z 59) but little molecular weight or functional group information.

Dichlorobenzene isomers were detected in several VOST samples at levels up to 200 ng. These compounds, however, were detected at varying and relatively short retention times and were also found in system blanks. This suggests that dichlorobenzene was not eluting from the GC during the analysis of the sample in which it was actually present but during a later GC/MS analysis. Therefore, dichlorobenzene isomers were not reported.

3.5.3 Identification of Semivolatile Compounds

Reported semivolatile compounds found in the MM5 train samples include compounds with GC/MS total ion areas of greater than approximately three times the background area. Background areas varied during analysis, but in general the lowest amount included in the tables is 5 μg per MM5 train.

Semivolatile compounds were semiquantitated using their GC/MS total ion areas and assuming a response factor of 1.0 relative to the total ion area of the internal standard 4,4'-dibromobiphenyl. The data have been blank corrected for compounds found in laboratory or MM5 train blanks.

Semivolatile compound identification involved interpretation of their electron impact mass spectra. A computer search of the NBS mass spectral library was performed for each unknown spectrum, followed by manual evaluation of the spectra and search results. Manual searches of the NBS library were also used to facilitate identifications. The computer search often gave erroneous results for the reasons previously noted for the VOST unknowns - i.e., unknown spectra were of mixtures or were of compounds whose spectra were not in the library. In addition, the major components in the MM5 samples were oxygenated aliphatic compounds. This type of compound is frequently misidentified by computer searches since molecular ions may be of low intensity or nonexistent and fragmentation may be dominated by low mass ions providing little distinguishing structural information. For these reasons, even in cases where the computer search provided a match with a high FIT*, the identification was scrutinized with consideration given to both the spectra and the retention time.

GC conditions during this analysis were sufficient to elute all EPA Method 625 priority pollutants. With the exception of phthalates, few of these compounds were actually found in the samples.

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* In the Finnigan INCOS data system FIT measures the resemblance of a library spectrum to an unknown spectrum, excluding peaks in the unknown not present in the library spectrum. The higher the FIT, the better the match.

All MM5 trains contained on the order of 0.1 g of 4-hydroxy-4-methyl-2-pentanone (diacetone alcohol) as the major component. Related compounds, such as 4-methyl-3-penten-2-one and 4-methyl-2-pentanone, were also detected at high levels. These compounds were present at comparable levels in the blank trains and are therefore not included in the tables. They were either not detected or were found at substantially lower levels in the laboratory blanks. 4-Hydroxy-4-methyl-2-pentanone is the Aldol condensation product of acetone under basic conditions and may be forming by reaction of acetone used to rinse the MM5 trains. The presence of these compounds at levels which are high relative to incineration related species can cause background and coelution problems, thus hindering the detection or identification of some species of interest. For example, peaks corresponding to EPA method 625 priority pollutants, phenol, 2-chlorophenol, and dichlorobenzene isomers would be totally obscured by the 4-hydroxy-4-methyl-2-pentanone peak. This is illustrated by Figure 3-2 which shows the total ion chromatograms of typical MM5 samples and of a standard mixture of EPA Method 625 priority pollutants.

Attempts were made to interpret the spectra of all semivolatile compounds present at the levels previously indicated; however, many compounds could not be identified. A high background and/or coeluting compounds often resulted in poor quality spectra, thus hindering identifications. Also, the majority of the compounds are aliphatic--and particularly oxygenated aliphatic--which, for the reasons noted previously, are often difficult to identify by electron impact mass spectrometry alone even under the best conditions. "CHO Compound" refers to a $C_xH_yO_z$ compound of unknown molecular weight and structure. The mass spectra of these species contain common oxygenated aliphatic ions such as $C_2H_5O^+$ (m/z 45) and $C_3H_7O^+$ (m/z 59), but no ions that allow definitive functional group characterization. In general, the spectra contain significant alkyl fragmentation and suggest that these compounds are not highly oxygenated.

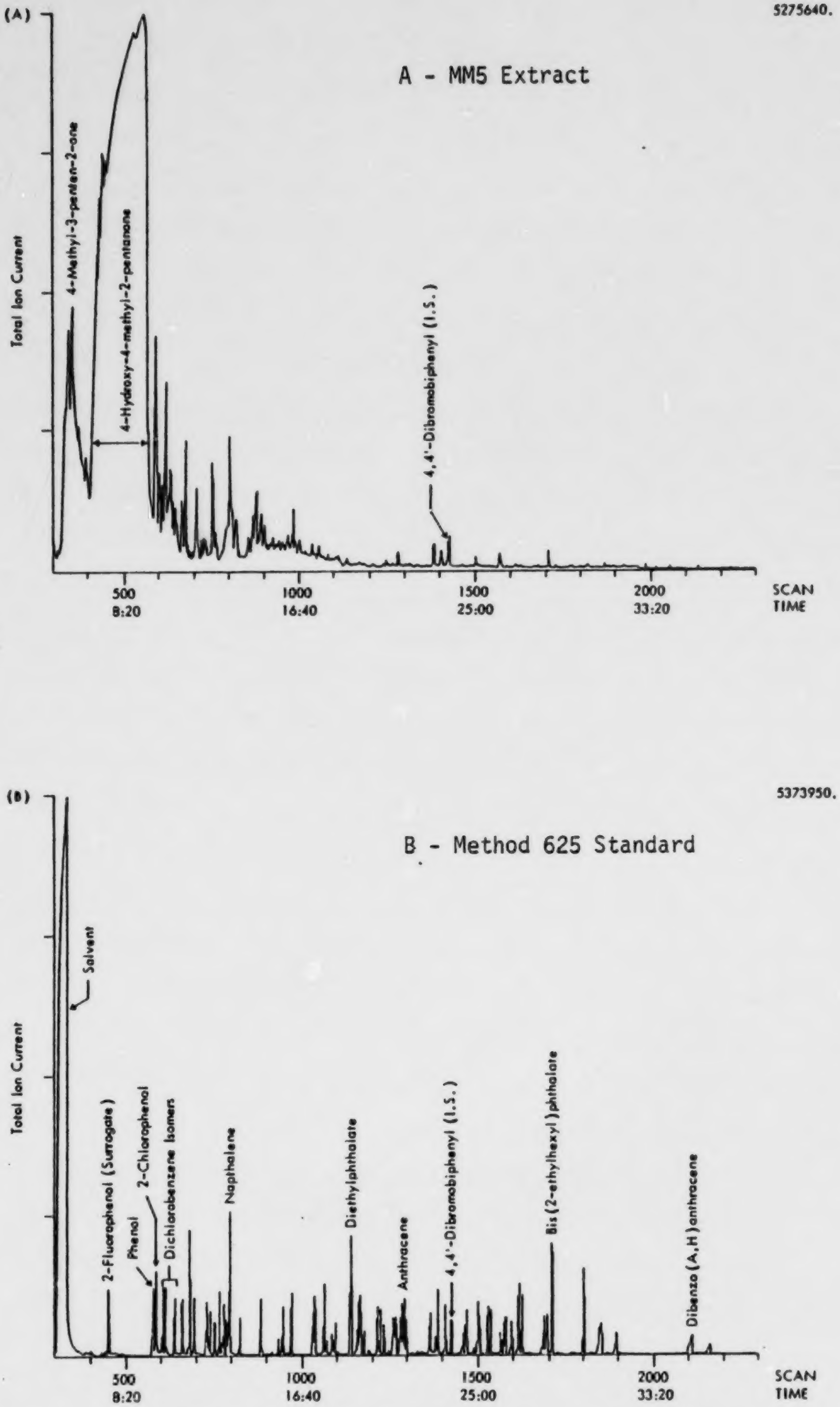

Figure 3-2. GC/MS chromatograms of a MM5 extract A and a Method 625 standard B.

Several long chain carboxylic acids were identified in the MM5 samples. Some of these compounds were also detected at lower levels in the blank trains. The compounds specifically identified are either straight chain or have only a limited amount of branching. For the compounds identified as do-, tetra-, penta-, hexa-, and octa- decanoic acid, excellent agreement is seen between sample spectra and NBS library spectra of the straight chain acids. For species identified as unsaturated acids, their spectra contain molcular ions as well as $CH_3CO_2H^+$ (m/z 60) which is characteristic of carboxylic acids. The samples may also contain branched acids which are not identified as such. As the degree of alkyl chain branching increases, the electron impact mass spectra of carboxylic acids become less characteristic and it is often difficult to even recognize the spectrum as that of a carboxylic acid. Also, higher molecular weight carboxylic acids (and esters) give more characteristic spectra, with more abundant molecular ions, than lighter acids. Thus, acids lighter than dodecanoic acid may be present in the MM5 samples but not be identified specifically.

The samples have several components whose spectra contain m/z 61 ($CH_3CO_2H_2^+$). This ion is often found in the spectra of acetates (esters of acetic acid), therefore these compounds are listed as "Acetate." These compounds may not all be acetates, but they should at least be oxygenated aliphatic compounds.

Compounds whose spectra contain only alkyl ions in ratios consistent with aliphatic hydrocarbons are reported as the chemical formula if the spectrum has a molecular ion, otherwise the term "Hydrocarbon" is used. These compounds appear to be alkanes with either a straight chain or limited branching. For the hydrocarbons eluting at scans 1871 and higher, the number of carbons is 20 or greater.

The spectra of the halogenated compounds reported reveal obviously halogenated ions based on isotopic abundances. In addition, excellent NBS library matches exist for the spectra identified as 1,1,1-trichloro-2-methyl-2-propanol and chlorocyclohexanol. Other halogenated compounds may be present but not identified as such since some aliphatic halogenated compounds do not yield obvious halogenated fragments by electron impact.

The MM5 samples contain few aromatic compounds. The unidentified aromatic compound at scan 727 is oxygenated and may be a phthalate. The spectrum at scan 1899 shows a dominant m/z 149 ($C_8H_5O_3^+$) characteristic of phthalates; the retention time suggests a mass greater than dioctyl phthalate.

Naphthalene, an EPA method 625 priority pollutant commonly found in incineration samples, was detected in all MM5 samples; however, coelution with 1-fluoronaphthalene (a recovery internal standard) and an oxygenated aliphatic compound hindered quantitation. Visual inspection of the data suggests that naphthalene is present at levels on the order of 20 µg in all samples and is also present in the blank trains at comparable or only slightly lower levels.

The only other polyaromatic compound (PAC) found is a molecular weight 216 species at scan 1405. This compound is tentatively identified as 4H-furo[4,3-G][1] benzopyran-4,7,9-trione; however, a comparison of the unknown and library spectra reveal some differences which suggest that the unknown is not this compound but a related species. This compound was detected in the two blank MM5 trains, but at levels at least one-half that of the samples. The mass spectra of PACs are characteristically simple with abundant molecular ions; typically, affording excellent sensitivity for GC/MS analysis. Also, the sample preparation and GC/MS analysis procedures used for the MM5 samples are very appropriate for PACs (see Figure 3-2). Hence, PACs levels in the MM5 samples are likely very low relative to the other semivolatile compounds.

The majority of the MM5 sample compounds which were neither identified nor characterized are aliphatic oxygenates or hydrocarbons. Often inclusion on this list was a result of poor spectral quality due to the low level of the unknown, a high background, or coeluting compounds. In other cases, an ambiguous mass spectrum resulted in a compound being labeled "unknown." For example, the most abundant unidentified compound, at scan 857, has a spectrum suggesting an aliphatic branched ketone; however, no oxygenated ions of significant intensity are present (which is not unusual for ketones) and the possibility that the compound is a branched hydrocarbon cannot be ruled out.

SECTION 4.0

DISCUSSION OF RESULTS

The two major factors that provided the impetus for the study were: (a) to what extent can the constituents in all effluent waste streams be identified and quantified; and (b) what changes in the type and quantity of constituents occur if the incineration process undergoes a transient combustion upset? Many complex issues involving sampling and analysis procedures, incineration design and operating characteristics, and control equipment design and performance have a profound affect on the answers to these questions. The results of this study will not provide complete answers to both questions; however, they do provide information relative to one particular incinerator system and perhaps some insight into other incinerator systems.

Data from this study are presented in terms of all compounds emitted without distinguishing between PICs and residual waste constituents. The focus was on what and how much is emitted. Data on waste constituents is also presented to allow comparison to the compounds identified in the stack gases.

The results have been divided into general subject areas based, in part, upon the incinerator conditions being examined. The first subsection discusses the results obtained during the steady state conditions. This includes the waste constituents, the total hydrocarbon levels, carbon monoxide (CO) emission levels, and emissions of organics. The second subsection describes the results obtained for these same parameters under the transient upset conditions. In the third subsection, the total emissions for the various constituents are presented and discussed for each of the two operating conditions. Emission levels are presented in terms of total hydrocarbons, volatile constituents, and semivolatile constituents. The fourth subsection presents results for the analysis of chloride levels, particulate levels in the stack gas, and metal concentrations in the five waste feeds used in this study. In the last subsection, a brief discussion is presented on the quality of the results from this study.

4.1 STEADY STATE CONDITIONS

This subsection will present the results for the principal waste constituents, total hydrocarbons and CO, and specific organics emitted during the steady state conditions. The steady state conditions are similar to those under which the incinerator would operate during a trial burn.

4.1.1 Waste Constituents and DRE

The waste streams fed to the incinerator were of three general types: solids; liquid organic wastes; and aqueous wastes. Three different types of drummed solid wastes were used: chlorinated pyridine tars; polyethylene wax; and a substituted cellulose. The liquid organic waste consisted principally of a mixture of C_8 hydrocarbons which was deliberately spiked with carbon tetrachloride to a level of approximately 10%. The aqueous waste was runoff water collected on-site. Measured properties of the liquid organic waste and the aqueous waste were presented in Section 3.3.3. The results of the analyses of the liquid organic waste and the aqueous waste for volatile EPA Method 624 priority pollutants are presented in Section 4.5.

MRI and Dow independently analyzed the liquid organic waste for carbon tetrachloride content using different analytical procedures. MRI analyzed the waste by dilution with PEG followed by purge-trap GC/MS (EPA Methods 5030 and 8240 of SW-846). Dow used an extraction procedure (EPA Method 3580 of SW-846) followed by analysis using GC with a Hall detector. The results obtained by Dow showed better consistency between runs; therefore, their data for the carbon tetrachloride concentrations were used in this report. The results by MRI for Runs 1, 2, and 3 averaged 10.8 ± 9.4% (mean ± standard deviation). The Dow results are shown below for each of the runs during the steady state conditions.

Run No.	% Carbon Tetrachloride
1	10.4
2	10.4
3	10.3

For the liquid organic waste, no other priority pollutants were present in quantities greater than 0.5%, except for the carbon tetrachloride already discussed. The average levels for the priority pollutants present in this waste at levels less than 0.5% during Run Nos. 1 to 3 shown below. A summary of the levels of the constituent found in each of the runs is presented in Table 4-13 in Section 4.5.

Compound	Avg. Conc. (ppm)[a]
Benzene	166
Chlorobenzene	80
Chloroform	224
Ethylbenzene	79
Methylene chloride	1,047
Tetrachloroethylene	176
Toluene	144

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[a] Based on MRI analyses.

In addition to carbon tetrachloride, other volatile priority pollutants were measured in both the liquid organic waste and the aqueous waste. These data are presented in Section 4.5. The average values for the six volatile priority pollutants in the highest concentration in the aqueous waste are as follows for Run Nos. 1 to 3. See Table 4-14 in Section 4.5

for a summary of all of the volatile priority pollutants found in each of the runs.

Compound	Average Conc. (ppm) MRI	Average Conc. (ppm) Dow
1,1,1-Trichloroethane	13.8	19.0
Carbon tetrachloride	10.8	14.4
Methylene chloride	16.3	13.0
1,1,2-Trichloroethane	5.1	6.0
Tetrachloroethylene	2.7	4.0
Chloroform	2.5	2.6

In this study, the carbon tetrachloride was spiked into the liquid organic waste to provide a basis for the Destruction and Removal Efficiency (DRE) calculations. Based on the waste feedrates presented in Tables 3-4 and 4-13 for the liquid organic waste, the feedrates for carbon tetrachloride to the incinerator were approximately 17.2, 18.8, and 16.5 g/sec for Run Nos. 1, 2, and 3, respectively. Using these feedrates and the results of the volatile organic constituent analyses performed for the stack gas, the DREs calculated for the carbon tetrachloride for the runs under steady state conditions were as follows:

Run No.	DRE (MRI)	DRE (Dow)
1	99.9985	99.9992
2	99.99998	99.9997
3	99.9995	99.9998

4.1.2 THC and Carbon Monoxide

The average concentrations of carbon monoxide and THC during the steady state runs are shown in Table 4-1. The difference between the EPA van and Dow CO values are not unusual, considering the values are all near the practical resolution of carbon monoxide analyzers of about 1 ppm. The CO analyzers are also subject to small interferences, up to 20 ppm, from water and carbon dioxide. Both analyzers were, however, corrected for these interferences. The high reading observed during Run No. 1 in the EPA van was brief and observed on only one of the analyzers (see footnote to Table 4-1).

TABLE 4-1. AVERAGE CO AND THC LEVELS (STEADY STATE CONDITIONS)

	CO (ppm)		THC (ppm methane)	
Run No.	EPA van	Dow	MRI	Dow
1	< 1 (0-86)*	3.5 (3-4)	7.6 (7.4-9.0)	ND
2	NA	3.5 (2.6-4.7)	6.8 (5.8-7.9)	ND
3	< 1 (0-2.5)	2.7 (2.5-3.3)	6.2 (4.9-10.0)	ND

Note: All concentrations are on dry gas basis. Numbers in parentheses are the range of readings for each run.

NA = not available.

ND = not detected.

* All levels were less than 1 ppm with the exception of one 3-min interval during which the CO levels peaked at 86 ppm.

For THC, there were some differences between the Dow and MRI instruments. The MRI analyzer used a hot, heat-traced sample system and thus measured wet stack gas which was then corrected to an ambient basis using the MM5 data. The DOW THC analyzer operated with an unheated sample line and thus was already measuring ambient gas. Its readings can be expected to be lower due to the water condensation occurring in its gas conditioning system with possible loss of water soluble organics. The MRI readings also had some uncertainty due to severe electronic interference. Because of this interference, the values could only be read within about 1 ppm.

During these runs the analyzers showed slowly changing readings with most of the variation due to instrument drift rather than process changes.

4.1.3 Organic Emissions

The combustion of organic materials in an incinerator and the resultant formation of the products of the incomplete combustion (PICs) are always in a dynamic state. Regardless of the degree of control over the incinerator operating parameters, the products resulting from the combustion will not be identical from one time period to another; concentrations of specific compounds will vary with time. Thus, although the specific composition of the feed waste may be known, this information only provides an indication of the types of combustion products that may be present.

For the present study, the several types of waste feeds provide a wide variety of feed compounds that may influence the potential composition of the stack gases. A very brief description of the principal constituents of each waste feed is provided to give an indication of the nature of the feed. The liquid organic waste and the aqueous waste previously were identified in terms of the principal constituents. To reiterate those results, the liquid organic waste is primarily C_8 hydrocarbons spiked with approximately 10% carbon tetrachloride; the aqueous waste contains several chlorinated aliphatic hydrocarbons. The polyethylene wax is a long-chain polymeric system composed only of carbon and hydrogen with multiple carbon-carbon double bonds. The chlorinated pyridines are composed of chlorine, carbon, hydrogen, and nitrogen. Pyridine is a six-membered unsaturated ring containing five carbon atoms and one nitrogen atom. Since this waste is pyridine tars, little information is available concerning the specific constituents. The substituted cellulose waste contains one or more alkyl or substituted alkyl groups attached to a cellulose molecule. Cellulose is a polymeric system composed of repeating $C_6H_{10}O_5$ units.

Another indication of the types of compounds that may be found in incinerator stack gases is the results of previous tests. A preliminary assessment of the current literature has been made for compounds emitted from stacks of combustion devices (Trenholm and Lee, 1986). This review showed that 55 compounds were detected in the stack emissions due to the combustion of hazardous waste. Of these compounds, nine volatile and six semivolatile compounds were found to occur most frequently and in the highest concentrations. These compounds are listed below for comparison to the compounds identified in this study.

Volatiles	Semivolatiles
Benzene	Naphthalene
Toluene	Phenol
Carbon tetrachloride	Bis(2-ethylhexyl)phthalate
Chloroform	Diethylphthalate
Methylene chloride	Butylbenzylphthalate
Trichloroethylene	Dibutylphthalate
1,1,1-Trichloroethane	
Chlorobenzene	
Tetrachloroethylene	

The stack concentrations of the volatile organic compounds found during Run Nos. 1 to 3 under the steady state conditions are presented in Table 4-2. This table provides the constituent levels for each run and the average for the three runs for the data reported by MRI and Dow. The methane and chloromethane data were obtained by GC analyses of periodic grab samples (typically 3-5 injections/test run) and may represent an average level different than the other constituents which were collected by the VOST procedure, a time-weighted average sample.

In Table 4-2, the results shown for Run Nos. 1 and 3 are for both the MRI sampling and analysis and the parallel sampling and analysis performed by Dow. The results of analysis of MRI's VOST traps from Run No. 2 were incomplete due to mishaps during transit and analysis. The Tenax trap from pair 2 was broken in transit, and equipment malfunction voided the analysis of the Tenax trap of pair 1 and the Tenax/charcoal trap of the trip blank pair. The field blank pair and the third sample pair from Run No. 2 were

TABLE 4-2. STACK CONCENTRATIONS OF VOLATILE CONSTITUENTS DURING STEADY STATE CONDITIONS

	Concentration (ppb)											
	Run 1			Run 2			Run 3			Avg. 1-3		
Constituent	MRI (VOST)	MRI (GC)	Dow (VOST)	MRI (VOST)	MRI (GC)	Dow (VOST)	MRI (VOST)	MRI (GC)	Dow (VOST)	MRI (VOST)	MRI (GC)	Dow (VOST)
Priority Pollutants												
Methyl chloride	4.4	226.0	29.6	NA	309.9	3.7	1.7	102.8	0.0	3.1	212.9	11.1
Methyl bromide	0.0	0.0	0.0	NA	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0
Vinyl chloride	0.9	1.9	2.1	NA	2.8	0.0	0.6	6.6	0.0	0.8	3.8	0.7
Dichloromethane	2.4	4.7	0.9	NA	1.1	0.7	1.0	1.2	0.8	1.7	2.3	0.8
Trichlorofluoromethane	4.1		0.0	NA		0.0	0.1		0.0	2.1	0.0	0.0
1,1-Dichloromethylene	1.0	0.0	0.0	NA	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0
Chloroform	62.2	15.4	16.3	NA	37.5	30.7	64.2	36.1	26.2	63.2	29.6	24.4
1,2-Dichloroethane	2.6		1.2	NA		1.3	0.2		0.2	1.4	0.0	0.9
1,1,1-Trichloroethane	0.2	0.0	0.2	NA	0.4	1.5	1.2	0.0	0.8	0.7	0.1	0.8
Carbon tetrachloride	3.8	0.3	2.0	NA	0.6	0.8	1.3	1.0	0.6	2.5	0.6	1.1
Dichlorobromomethane	14.0	4.4	4.4	NA	7.8	5.6	13.4	6.0	5.7	13.7	6.1	5.2
1,2-Dichloropropane	1.2	0.0	0.0	NA	0.0	0.0	0.0	0.1	0.0	0.6	0.0	0.0
Trichloroethylene	0.1	0.0	NA	NA	2.3	NA	0.1	0.0	NA	0.1	0.8	NA
Benzene	4.6	3.0	8.0	NA	6.4	11.4	1.7	3.0	3.4	3.1	4.1	7.6
Chlorodibromomethane	2.3		1.3	NA		0.9	1.7		0.8	2.0	0.0	1.0
2-Chloromethyl vinyl ether	1.8		0.0	NA		0.0	0.2		0.0	1.0	0.0	0.0
Bromoform	0.1		1.2	NA		0.1	0.0		0.0	0.1	0.0	0.4
1,1,2,2-Tetrachloroethylene	1.2		0.4	NA		0.3	0.4		0.3	0.8	0.0	0.3
Toluene	7.9	0.0	7.3	NA	0.0	2.4	0.9	0.0	4.7	4.4	0.0	4.8
Chlorobenzene	0.1	0.0	0.1	NA	0.0	0.1	0.1	0.0	0.1	0.1	0.0	0.1
Ethylbenzene	1.0	0.0	0.7	NA	0.0	0.2	0.1	0.0	0.1	0.6	0.0	0.3
Total	116.0	255.7	NA	NA	368.8	NA	89.1	156.7	NA	102.6	260.4	NA
Nonpriority Pollutants												
C_3H_4	0.0			NA			0.0			0.0		
Dimethyl ether	18.8			NA			0.3			9.6		
Dichlorodifluoromethane	0.2			NA			0.2			0.2		
Acetonitrile	0.0			NA			0.1			0.1		
C_4H_{10}	0.0			NA			0.2			0.1		
C_4H_8/Acetone	4.1	0.0		NA	3.4		3.4	9.4		3.7		
Chloropropene	0.0			NA			0.2			0.1		
Bromochloromethane	0.0			NA			0.0			0.0		
Tetrahydrofuran/C_5H_{12}	0.4			NA			0.1			0.2		
C_5H_8/C_5H_{10}	0.0			NA			0.2			0.1		
C_5H_{12}/C_6H_{12}	0.8			NA			0.2			0.5		
C_6H_{12}/C_6H_{14}	1.8			NA			0.1			0.9		
$C_5H_{12}O_2$	0.0			NA			0.0			0.0		
C_6H_{12}	0.2			NA			0.0			0.1		

(continued)

TABLE 4-2. (Concluded)

Constituent	Concentration (ppb)											
	Run 1			Run 2			Run 3			Avg. 1-3		
	MRI (VOST)	MRI (GC)	Dow (VOST)	MRI (VOST)	MRI (GC)	Dow (VOST)	MRI (VOST)	MRI (GC)	Dow (VOST)	MRI (VOST)	MRI (GC)	Dow (VOST)
Nonpriority Pollutants (continued)												
Dichloroacetonitrile	3.2			NA			0.6			1.9		
C_7H_{14}/C_6H_{12}	0.0			NA			0.1			0.0		
C_7H_{14}/C_7H_{16}	7.2			NA			0.4			3.8		
C_6H_{12}	0.0			NA			0.1			0.0		
C_7H_{14}/C_7H_{16}	1.1			NA			0.1			0.6		
Hydrocarbon	0.1			NA			0.1			0.1		
C_7H_{12}	0.0			NA			0.0			0.0		
Isooctane	1.2			NA			0.8			1.0		
Hydrocarbon	1.2			NA			0.1			0.6		
Total	40.2	0.0	0.0	NA	3.4	0.0	7.4	9.4	0.0	23.8	4.3	0.0

analyzed successfully. However, the resulting data package for Run 2 was deemed too incomplete to use. For this reason, only the Dow results were used for Run No. 2.

Comparison of the two sets of analytical results from Dow and MRI provides some perspective on the variability of results that may be anticipated in the measurement of low levels of volatile organic constituents in incinerator stack gases. While an overall comparison of the two sets of results shows fairly good agreement, some levels may differ by a factor of seven or eight; in all cases where comparison of the two numbers can be made, the levels found by each analysis agree within an order of magnitude.

In general, the volatile organic constituents found in the incinerator stack gas during the steady state conditions are aromatic and aliphatic hydrocarbons and halogenated hydrocarbons, primarily chlorinated aliphatic hydrocarbons. Acetonitrile and dichloroacetonitrile were the only volatile nitrogen-containing compounds identified. The presence of the hydrocarbons and the chlorinated hydrocarbons as the principal organic emissions is not surprising considering the composition of the liquid organic waste. In terms of specific volatile organic constituents, the principal constituent found by MRI was methane at an average level of approximately 1,400 ppb. Two other compounds present in major quantities were chloromethane at an average concentration of 213 ppb (based on field GC data) and chloroform with an average level of 63 ppb (based on VOST data). The data obtained by Dow showed chloroform to be a major volatile organic constituent of the stack gas at an average level of 24 ppb.

The MRI data and the Dow data show the presence of brominated methanes, chlorinated methanes, and bromochloromethanes in the stack gases. As shown in Table 4-15 in Section 4.5, these compounds are also constituents of the scrubber makeup water. An initial conclusion could be that the presence of these compounds in the stack gases resulted from volatilization of the compounds into the stack gas as it passed through the scrubber system. MRI calculated the maximum contribution from the scrubber water to the stack gas concentrations using the flow rate (ng/min) of the particular compound in the scrubber water and the total emissions in the stack gas in the same units. The results showed that the maximum contribution from the scrubber water to the stack gas emission rate was approximately 5% or less for each of the specific compounds.

Earlier in this subsection, the results of a preliminary assessment by Trenholm and Lee was presented for the volatile and semivolatile compounds often observed in stack emissions. Of the nine volatile compounds stated to be commonly observed, all except trichloroethylene were observed in the stack gas emissions during Run Nos. 1 to 3 of this study. Of the eight compounds observed, all were present as constituents in one of the waste feeds used for the incinerator. Of the eight compounds, only chloroform was found to be present in appreciable quantities, greater than 10 ppb; all others were present in average concentrations of less than 5 ppb.

The stack concentrations of the semivolatile organic constituents found in the stack gas during Run Nos. 1 to 3 under the steady state conditions are presented in Table 4-3. Table 4-4 provides a summary of the total concentrations for the various classes of compounds found to comprise the semivolatiles. The concentrations are given for each of the three runs and an average for all three runs.

The results show that the semivolatile constituents are comprised of four classes of compounds plus one group of unidentified compounds (for details see Appendix B). The four classes of compounds are: aliphatic hydrocarbons; aromatic hydrocarbons; chlorinated aliphatic hydrocarbons; and oxygenated aliphatic compounds. Averaged over all three runs, the oxygenated aliphatic compounds comprise the largest group of the four classes of compounds, both in terms of the total number of species and the total quantity. This group contains about 43 species and comprises approximately 65% of the total quantity of the semivolatiles. The next largest group in terms of the percentage of the total quantity is the chlorinated aliphatic hydrocarbons which account for about 17% of the total quantity although the class only contains three compounds.

TABLE 4-3. STACK CONCENTRATIONS OF SEMIVOLATILE CONSTITUENTS DURING STEADY STATE CONDITIONS

Compounds	Concentration (µg/m³) Run 1	Run 2	Run 3
Oxygenated aliphatic compounds			
3,4-Dihydro-6-methyl-2,4-pyran	15.65		6.10
CHO compounds			128.81
Acetate	388.68	251.25	592.31
5-Methylhexen-2-one			111.71
CHO compound		241.81	
Carboxylic acid			212.99
CHO compound	464.97	168.05	
Acetate			46.41
CHO compound	273.97		82.37
CHO compound		28.03	217.81
CHO compound	66.49		
Carboxylic acid	121.18		
CHO compound			7.29
CHO compound			44.58
Acetate			61.60
Octyl acetate	210.51	56.83	
Acetate			48.96
Acetate			44.98
CHO compound	37.99	25.80	
CHO compound	47.90		9.20
Acetate	223.97	43.93	
CHO compound	56.82		8.55
CHO compound	91.07	33.70	71.75
CHO compound		9.03	9.44
Dodecanoic acid isomer	12.81		2.23
Dodecanoic acid	83.75	33.66	88.87
CHO compound			11.12
Tetradecanoic acid	28.36	21.17	34.81
CHO compound			
Pentadecanoic acid			9.69
Pentadecatrienoic acid		7.48	
Hexadecanoic acid	38.99	65.32	77.29
Heptadecatrienoic acid	9.03	13.85	12.80
CHO compound	51.63	30.84	37.34
Butyl octadecanoate	2.41	5.31	
Totals	2,226.18	1,036.07	1,979.00

(continued)

TABLE 4-3. (continued)

Compounds	Concentration (μg/m³) Run 1	 Run 2	 Run 3
Halogenated compounds			
1,1,1-Trichloro-2-methyl-2-propanol		95.87	46.09
Chlorocyclohexanol	176.10	135.72	164.91
CHOCl compound	373.30	334.37	
Totals	549.41	565.97	211.00
Aromatics			
Methyl benzoate			29.51
Aromatic compound		12.20	20.40
Diethyl phthalate		38.22	33.32
4,4-Furo[3,2-6]benzopyran-4,1,9-trione	32.36	36.90	40.48
Totals	32.36	87.32	123.71
Aliphatic hydrocarbons			
Cl_4H_3O	23.72	10.71	28.16
Hydrocarbon	9.55		
Hydrocarbon	8.94		
Totals	42.21	10.71	28.16
Unknowns			
Unknown			11.31
Unknown		85.84	21.43
Unknown		75.15	
Unknown	37.77	18.41	27.71
Unknown		119.56	
Unknown	370.47	106.86	
Unknown		33.07	
Unknown	10.84	10.36	22.77
Unknown			9.06
Unknown	19.63		17.49

(continued)

TABLE 4-3. (continued)

	Concentration ($\mu g/m^3$)		
Compounds	Run 1	Run 2	Run 3
Unknowns (con't)			
Unknown			13.12
Unknown			3.99
Unknown	20.16		7.37
Unknown			7.43
Unknown	4.18		
Unknown	14.31	15.44	
Unknown	9.30	6.69	
Unknown	15.86	19.37	
Unknown			4.75
Unknown	5.37		
Totals	507.90	490.74	146.42

TABLE 4-4. SUMMARY OF STACK CONCENTRATIONS OF SEMIVOLATILE CONSTITUENTS DURING STEADY-STATE CONDITIONS

Constituent class	Total concentration (μg/m³)			
	Run 1	Run 2	Run 3	Average
Oxygenated aliphatic compounds	2,226	1,036	1,979	1,747
Chlorinated aliphatic hydrocarbons	549	566	211	442
Aromatic hydrocarbons	32	87	124	81
Aliphatic hydrocarbons	42	11	28	27
Unknown compounds	508	491	146	382

The group of unidentified compounds comprises about 14% of the total quantity. The aliphatic and aromatic hydrocarbons comprise a very small percentage of the total quantity of the semivolatiles; the aromatic compounds account for about 3%, and the aliphatic compounds account for approximately 1%.

Of the semivolatile compounds identified by Trenholm and Lee as being common constituents of the stack gas emissions, only diethyl phthalate was identified at significantly above blank levels. None of the other five compounds, including naphthalene, were identified as being present in the stack gas emissions from Run Nos. 1 to 3.

The oxygenated aliphatic category of compounds includes both aldehydes and ketones, among other classes. During the stack sampling conducted for all runs, a special aldehyde train was employed in addition to the normal MM5 and VOST units. Analyses of the samples from Run Nos. 1 to 3 were performed for formaldehyde and total aldehyde content. The results showed appreciable levels of total aldehydes for the steady state conditions; formaldehyde levels constituted approximately 50% of the total quantity.

However, the total aldehyde levels in the blank samples were sufficiently high relative to the sample values that quantitation of the total aldehyde results was not feasible. No further conclusions were drawn from the results of the aldehyde analysis.

4.2 TRANSIENT UPSET CONDITIONS

This subsection will present the results for the principal waste constituents and DRE, total hydrocarbons and CO, and the specific organic emissions observed during the transient upset conditions.

4.2.1 Waste Constituents and DRE

The waste streams fed to the incinerator were the same as those used for the steady state conditions and were described in Section 4.1.1. Measured properties of the liquid organic waste and the aqueous waste were presented in Section 3.3.3.

The results obtained by Dow for the carbon tetrachloride concentrations are shown below for each of the runs during the transient upset conditions.

Run No.	% Carbon Tetrachloride
4	10.2
5	10.1
6	10.1

No other priority pollutants were present in the liquid organic waste in quantities greater than 0.5%. The average levels for the priority pollutants present in this waste at levels less than 0.5% during Run Nos. 4 to 6 are presented below. A summary of the levels of the constituent found in each of the runs is provided in Table 4-13 in Section 4.5.

Compound	Average Conc. (ppm)[a]
Benzene	270
Chlorobenzene	345
Chloroform	1,412
Ethylbenzene	186
Methylene chloride	251
Toluene	210

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[a] Based on MRI analyses.

In addition to carbon tetrachloride, other volatile priority pollutants were measured in both the liquid organic waste and the aqueous waste. These data are presented in Section 4.5. The average values for the six volatile priority pollutants in the highest concentration in the aqueous waste are shown below for Run Nos. 4 to 6. See Table 4-14 in Section 4.5 for a summary of all of the priority pollutants found in each of the runs.

Compound	Average conc. (ppm)	
	MRI	Dow
1,1,1-Trichloroethane	9.8	10.0
Carbon tetrachloride	6.0	7.2
Methylene chloride	6.2	6.3
1,1,2-Trichloroethane	2.9	2.2
Tetrachloroethylene	1.4	8.9
Chloroform	1.7	0.8

The feedrates for carbon tetrachloride to the incinerator were approximately 16.4, 17.2, and 16.7 g/sec for Run Nos. 4, 5, and 6, respectively. Using these feedrates and the results of the volatile organic constituent analyses performed for the stack gas, the DREs calculated for the carbon tetrachloride for the runs under transient upset conditions were as follows:

Run No.	DRE (MRI)	DRE (Dow)
4	99.9969	99.9997
5	99.9949	99.9995
6	99.9985	99.9995

4.2.2 THC and Carbon Monoxide

The average concentrations of CO and THC observed during the transient condition runs are shown in Table 4-5. The averages are generally slightly higher than those observed at steady state.

TABLE 4-5. AVERAGE CO AND THC LEVELS DURING TRANSIENT UPSET CONDITIONS

	CO (ppm)		THC (ppm methane)	
Run No.	EPA van	Dow	MRI	Dow
4	10 (0-720)	20 (2-691)	8.8 (4.1-161)	NA
5	11 (0.5-710)	7.9 (1.6-538)	145 (103-224)	99 (79-149)
6	15 (0-710)	33 (6.2-819)	106 (79-188)	60 (55-63)

Note: All concentrations are on dry gas basis. Numbers in parentheses are the range of readings for each run.

NA = not available.

During the transient runs the CO analyzer responses were characterized by generally low readings with brief large excursions during the transient upsets. The width of the upset spikes, occurring once every 30 min, was measured on the MRI THC analyzer as less than 1 min. The CO analyzers generally showed wider spikes due to their slower response. The differences in response times and frequency of data collection between instruments probably resulted in a variation in the readings. This would affect the maximum values more than the average values.

For THC, Run No. 4 was similar to the carbon monoxide response. For the last two runs the THC response of the sample stream remained high at all times with constant cycling over several minutes. The primary reason for the elevated readings was unburned methane possibly from the auxiliary burners which are fed with natural gas. Thus the high THC readings during these two runs are not due to poor waste feed combustion.

4.2.3 Organic Emissions

The stack concentrations of the volatile organic compounds found during Run Nos. 4 to 6 under the transient upset conditions are presented in Table 4-6. This table provides the constituent levels for each run and the average for the three runs for the data reported by MRI and Dow.

In Table 4-6, the results shown for Run Nos. 4 to 6 are for both the MRI sampling and analysis and the parallel sampling and analysis performed by Dow. An overall comparison of the two sets of results shows fairly good agreement.

In general, the volatile organic constituents found in the incinerator stack gas during the transient upset conditions are aromatic and aliphatic hydrocarbons and halogenated hydrocarbons, primarily chlorinated aliphatic hydrocarbons. Acetonitrile and dichloroacetonitrile were the only volatile nitrogen-containing compounds identified. In terms of specific volatile organic constituents, the principal constituent found by MRI was methane at an average level of approximately 49,400 ppb. For the transient runs, four other compounds were present in major quantities. Chloromethane was present at an average concentration of 236 ppb, based on field GC data. Dichloromethane, chloroform, and benzene were present at average levels of 80, 38, and 45 ppb, respectively (based on VOST data). The data obtained by Dow showed these same compounds to be major volatile organic constituents of the stack gas at average levels of 26, 14, and 14 ppb, respectively.

TABLE 4-6. STACK CONCENTRATIONS OF VOLATILE COMPOUNDS DURING TRANSIENT UPSET CONDITIONS

	Concentration (ppb)											
	Run 4			Run 5			Run 6			Avg. 4-6		
Constituent	MRI (VOST)	MRI (GC)	Dow (VOST)	MRI (VOST)	MRI (GC)	Dow (VOST)	MRI (VOST)	MRI (GC)	Dow (VOST)	MRI (VOST)	MRI (GC)	Dow (VOST)
Priority Pollutants												
Methyl chloride	5.0	201.3	2.3	46.9	194.8	143.2	108.2	312.9	81.1	53.4	236.3	75.5
Methyl bromide	2.4	0.0	NA	3.8	0.0	NA	4.2	0.0	3.0	3.5	0.0	NA
Vinyl chloride	0.7	1.3	NA	1.8	4.1	NA	2.8	2.8	0.7	1.8	2.7	NA
Dichloromethane	3.2	0.0	1.7	148.5	50.7	39.7	89.0	14.5	36.9	80.2	21.7	26.1
Trichlorofluoromethane	0.1		0.0	0.2		NA	0.6		NA	0.3	0.0	NA
1,1-Dichloromethylene	0.1	0.0	0.0	0.3	0.0	0.1	0.3	0.0	0.1	0.2	0.0	0.2
Chloroform	72.0	0.0	28.2	24.1	5.7	3.8	17.5	0.0	9.9	37.9	1.9	14.0
1,2-Dichloroethane	0.5		0.5	0.1		0.1	0.5		0.3	0.4	0.0	0.3
1,1,1-Trichloroethane	0.7	0.0	0.4	0.4	0.0	0.2	0.2	0.0	0.3	0.5	0.0	0.3
Carbon tetrachloride	7.3	1.3	0.7	11.5	1.2	1.1	3.3	0.0	1.1	7.4	0.8	1.0
Dichlorobromomethane	16.1	5.6	6.8	1.2	0.0	0.2	3.0	0.0	2.1	6.8	1.9	3.0
1,2-Dichloropropane	0.0	0.0	NA	0.0	0.0	NA	11.5	0.0	NA	3.8	0.0	NA
Trichloroethylene	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.2	0.1	0.0	0.1
Benzene	61.3	3.4	25.0	18.9	2.2	10.8	54.1	42.6	7.4	44.8	16.1	14.4
Chlorodibromomethane	4.6		0.5	0.5		0.2	0.3		0.2	1.8	0.0	0.3
2-Chloromethyl vinyl ether	1.0		NA	1.9		NA	0.5		NA	1.1	0.0	NA
Bromoform	6.3		11.5	0.6		0.5	0.1		0.1	2.4	0.0	4.0
1,1,2,2-Tetrachloroethylene	0.3		0.2	0.2		0.0	0.1		0.0	0.2	0.0	0.1
Toluene	1.7	0.0	1.4	0.9	0.0	11.3	0.7	0.0	2.0	1.1	0.0	4.9
Chlorobenzene	0.6	0.0	0.2	0.6	0.0	0.4	0.6	0.0	0.5	0.6	0.0	0.4
Ethylbenzene	0.8	0.0	0.0	0.2	0.0	0.0	0.1	0.0	0.1	0.4	0.0	0.0
Total	184.9	212.8	NA	262.6	258.7	NA	297.7	372.7	NA	248.4	281.4	NA
Nonpriority Pollutants												
C_3H_4	0.6			0.0			1.1			0.6		
Dimethyl ether	1.0			0.9			1.0			1.0		
Dichlorodifluoromethane	1.0			0.1			0.1			0.1		
Acetonitrile	0.4			0.5			0.1			0.3		
C_4H_{10}	0.8			0.0			0.0			0.3		
C_4H_8/Acetone	7.1	0.0		4.5	11.5		4.7	2.9		5.5	4.8	
Chloropropene	0.3			0.0			0.0			0.1		
Bromochloromethane	0.0			1.2			7.2			2.8		
Tetrahydrofuran/C_5H_{12}	0.5			0.2			0.3			0.3		
C_5H_8/C_5H_{10}	0.0			0.3			0.0			0.1		
C_5H_{12}/C_6H_{12}	0.0			0.1			0.1			0.1		
C_6H_{12}/C_6H_{14}	0.5			1.1			0.0			0.5		
$C_5H_{12}O_2$	0.0			0.2			0.9			0.3		
C_6H_{12}	0.0			0.1			0.0			0.0		

(continued)

TABLE 4-6. (continued)

Constituent	Concentration (ppb)											
	Run 4			Run 5			Run 6			Avg. 4-6		
	MRI (VOST)	MRI (GC)	Dow (VOST)	MRI (VOST)	MRI (GC)	Dow (VOST)	MRI (VOST)	MRI (GC)	Dow (VOST)	MRI (VOST)	MRI (GC)	Dow (VOST)
Nonpriority Pollutants (continued)												
Dichloroacetonitrile	0.6			0.3			0.0			0.3		
C_7H_{14}/C_6H_{12}	0.0			0.2			0.0			0.1		
C_7H_{14}/C_7H_{16}	0.0			0.0			0.1			0.0		
C_6H_{12}	0.0			0.1			0.5			0.2		
C_7H_{14}/C_7H_{16}	1.4			0.2			0.2			0.6		
Hydrocarbon	0.1			0.1			0.0			0.1		
C_7H_{12}	0.4			0.4			0.3			0.3		
Isooctane	44.0			3.7			0.0			15.9		
Hydrocarbon	1.1			0.0			0.0			0.4		
Total	58.9	0.0		14.2	11.5		16.8	2.9		30.0	4.8	

The major changes that were observed to occur between the steady state conditions and the transient upset conditions were in the increased concentrations in the stack gas of methane, benzene, and dichloromethane (methylene chloride). Except for these three constituents, the concentration of essentially all of the other volatile and semivolatile constituents remained the same, or did not show any significant increases or decreases. The levels of benzene increased from an average of about 3 ppb in Run Nos. 1 and 3 to about 45 ppb in Run Nos. 4 to 6; This constitutes an increase by a factor of about 15. For methylene chloride, the increase was greater than for benzene. The levels of methylene chloride increased by a factor of approximately 47.

The MRI data and the Dow data show the presence of brominated methanes, chlorinated methanes, and bromochloromethanes in the stack gases. As shown in Table 4-15 in Section 4.5, these compounds are also constituents of the scrubber makeup water. MRI calculated the maximum contribution from the scrubber water to the stack gas concentrations and found that the maximum contribution from the scrubber water to the stack gas emission rate was approximately 5% or less for each of the specific compounds. This is the same result found for the steady state conditions.

Earlier in this subsection, the results of a preliminary assessment by Trenholm and Lee was presented of the volatile and semivolatile compounds often observed in stack emissions. Of the nine volatile compounds stated to be commonly observed, all were observed in the stack gas emissions during Runs Nos. 4 to 6 of this study. Of the nine compounds observed, eight were present as constituents in one of the waste feeds used for the incinerator. Of the eight compounds, methylene chloride, benzene, and chloroform were found to be present in appreciable quantities, greater than 30 ppb; all others were present in average quantities of less than 10 ppb.

The stack concentrations of the semivolatile organic constituents found in the stack gas during Run Nos. 4 to 6 under the transient upset condition are presented in Table 4-7. Table 4-8 provides a summary of the total concentrations for the various classes of compounds found to comprise the semivolatiles. The concentrations are given for each of the three runs and an average of the three runs.

TABLE 4-7. STACK CONCENTRATIONS OF SEMIVOLATILE CONSTITUENTS DURING TRANSIENT UPSET CONDITIONS

Compounds	Concentration ($\mu g/m^3$)		
	Run 4	Run 5	Run 6
Oxygenated aliphatic compounds			
sec-Butyl acetate	7.33		11.78
3,4-Dihydro-6-methyl-2,4-pyran		2.42	4.41
CHO compounds	13.98	34.71	366.35
Acetate	67.98		
5-Methylhexen-2-one		169.24	94.01
CHO compound	25.12		
Carboxylic acid		354.41	
Acetate		45.90	47.94
Acetate			42.25
CHO compound		133.58	46.22
CHO compound		347.31	355.19
CHO compound	42.01		47.46
Heptanone isomer		68.59	44.88
Carboxylic acid	178.03		139.46
CHO compound	46.97	141.05	
CHO compound	5.73		8.46
CHO compound	25.33		33.83
CHO compound	120.83	94.68	63.63
Acetate	53.19	72.54	
Acetate	85.12	170.46	61.50
Acetate	70.43	35.63	
CHO compound		157.82	45.00
CHO compound	14.75	27.21	9.25
Acetate	13.50		
CHO compound	14.84	17.66	11.40
CHO compound	15.11	26.45	
CHO compound	61.36	111.52	86.17
Acetate	5.17	14.72	8.10
CHO compound	4.04	23.83	
Dodecanoic acid	69.11	28.78	21.53
CHO compound	10.26		
CHO compound	4.51	4.90	
Tetradecanoic acid	40.53	17.87	17.43
CHO compound	13.96		6.07
Pentadecanoic acid	10.86	14.50	7.42

(continued)

TABLE 4-7. (continued)

Compounds	Concentration ($\mu g/m^3$)		
	Run 4	Run 5	Run 6
Oxygenated aliphatic compounds (con't)			
Pentadecatrienoic acid	15.31		
Hexadecanoic acid	72.42	60.77	44.25
Heptadecatrienoic acid	19.12	11.06	10.32
CHO compound	26.24	44.26	34.35
Butyl octadecanoate	6.40		
Totals	1,159.52	2,231.87	1,668.66
Halogenated compounds			
1,1,1-Trichloro-2-methyl-2-propanol			101.46
Chlorocyclohexanol	57.69	104.97	24.87
CHOCl compound	333.97		
Totals	391.66	104.97	126.33
Aromatics			
Methyl benzoate			23.14
Aromatic compound			24.38
Diethyl phthalate	364.07	23.80	24.62
4,4-Furo[3,2-6]benzopyran-4,1,9-trione	37.39	39.62	32.42
Phthalate	6.35		11.59
Totals	407.81	63.42	116.16
Aliphatic hydrocarbons			
$C1_4H_30$	9.04	30.15	20.17
Hydrocarbon		4.32	2.97
Hydrocarbon		6.43	
Hydrocarbon	8.17		6.57
Totals	17.21	40.90	29.70

(continued)

TABLE 4-7. (continued)

	Concentration ($\mu g/m^3$)		
Compounds	Run 4	Run 5	Run 6
Unknowns			
Unknown		45.22	10.75
Unknown	22.79		
Unknown	75.16		21.41
Unknown		5.51	
Unknown		59.58	
Unknown	11.01		28.64
Unknown	11.79		26.72
Unknown		17.55	
Unknown		34.30	
Unknown			4.91
Unknown		6.66	5.21
Unknown	7.82	10.75	14.86
Unknown		7.27	5.25
Unknown		14.90	5.27
Unknown		8.76	13.18
Unknown		6.29	
Unknown		6.96	5.33
Totals	128.57	223.76	141.52

TABLE 4-8. SUMMARY OF STACK CONCENTRATIONS OF SEMIVOLATILE CONSTITUENTS DURING TRANSIENT UPSET CONDITIONS

Constituent class	Total concentration (μg/m³)			
	Run 4	Run 5	Run 6	Average
Oxygenated aliphatic compounds	1,159	2,232	1,669	1,687
Chlorinated aliphatic hydrocarbons	392	105	127	208
Aromatic hydrocarbons	408	63	116	196
Aliphatic hydrocarbons	17	41	30	29
Unknown compounds	128	224	141	164

[a] Based on MRI analyses.

The results show that the semivolatile constituents are comprised of the same classes of compounds found for the steady state conditions (for details see Appendix B). Averaged over all three runs, the oxygenated aliphatic compounds comprise the largest group of the four classes of compounds, both in terms of the total number of species and the total quantity. This group contains about 43 species and comprises approximately 74% of the total quantity of the semivolatiles. The next largest group in terms of the percentage of the total quantity are the chlorinated aliphatic hydrocarbons which account for about 9% of the total quantity although the class only contains three compounds. The aromatic hydrocarbons comprise about 9% of the total quantity. The group of unknown compounds account for about 7% and the aliphatic compounds account for approximately 1%.

Of the semivolatile compounds identified by Trenholm and Lee as being common constituents of the stack gas emissions, only diethyl phthalate was identified at significantly above blank levels. None of the other five compounds, including naphthalene, were identified as being present in the stack gas emissions from Run Nos. 4 to 6.

The oxygenated aliphatic category of compounds includes both aldehydes and ketones, among other classes. During the stack sampling conducted for all runs, a special aldehyde train was employed in addition to the normal MM5 and VOST units. Analyses of the samples from Run Nos. 4 to 6 were performed for formaldehyde and total aldehyde content. For the transient upset conditions, the results showed approximately the same levels of total aldehydes as found for the steady state conditions. Formaldehyde levels constituted about 40% of the total quantity. However, the total aldehyde levels in the blank samples were sufficiently high relative to the sample values that quantitation of the total aldehyde results was not feasible. No further conclusions were drawn from the results of the aldehyde analyses.

4.3 TOTAL MASS EMISSIONS

The total mass (organic) emissions from the stack are summarized in Tables 4-9 and 4-10. The various measurements of organics have been converted to a common basis of dry gas as methane equivalent response using an FID. The values for THC, methane, and ethylene are based upon measured response ratios with methane on the analyzers actually used. Methane and ethylene were measured on the GC/FID in the EPA van. Other volatiles are based upon the sum of all GC/MS peaks observed in the MRI VOST traps except for methyl chloride which used the field GC/Hall detector. The methane equivalent responses are based upon the Effective Carbon Number for each compound.

Semivolatiles are the sum of the observed peaks from the GC/MS analysis of the MM5 train extract with no preliminary cleanup. The bulk of the semivolatile contents of the MM5 extracts was found to be due to carbonyl compounds. The results in Table 4-7 were calculated using a single factor of 0.5 for the average effective FID response. This factor is likely conservative since many of the higher molecular weight compounds have structures with 80 to 100% hydrocarbon skeleton. A higher assumed factor would increase the semivolatile contribution by up to 50%.

TABLE 4-9. STACK CONCENTRATIONS, AS ppb METHANE, OF VOLATILE CONSTITUENTS DURING STEADY STATE AND TRANSIENT UPSET CONDITIONS

	Concentration (as ppb methane)							
	Run 1		Run 2		Run 3		Avg. 1-3	
Constituent	MRI (VOST)	MRI (GC)	MRI (VOST)	MRI (GC)	MRI (VOST)	MRI (GC)	MRI (VOST)	MRI (GC)
Priority Pollutants								
Methyl chloride	4.2	214.7	NA	294.4	1.6	97.7	2.9	202.3
Methyl bromide	0.0	0.0	NA	0.0	0.1	0.0	0.1	0.0
Vinyl chloride	1.5	3.4	NA	4.8	1.1	11.5	1.3	6.6
Dichloromethane	2.1	4.2	NA	1.0	0.9	1.1	1.5	2.1
Trichlorofluoromethane	1.8		NA		0.0		0.9	0.0
1,1-Dichloromethylene	1.6	0.0	NA	0.0	0.1	0.0	0.8	0.0
Chloroform	52.9	13.1	NA	31.9	54.6	30.7	53.7	25.2
1,2-Dichloroethane	4.1		NA		0.3		2.2	0.0
1,1,1-Trichloroethane	0.4	0.0	NA	0.6	1.8	0.0	1.1	0.2
Carbon tetrachloride	2.5	0.2	NA	0.4	0.8	0.6	1.6	0.4
Dichlorobromomethane	11.9	3.7	NA	6.6	11.4	5.1	11.7	5.2
1,2-Dichloropropane	3.6	0.0	NA	0.0	0.0	0.3	1.8	0.1
Trichloroethylene	0.1	0.0	NA	3.5	0.1	0.0	0.1	1.2
Benzene	27.4	18.1	NA	38.4	10.1	18.0	18.7	24.8
Chlorodibromomethane	1.9		NA		1.5		1.7	0.0
2-Chloromethyl vinyl ether	5.7		NA		0.6		3.2	0.0
Bromoform	0.1		NA		0.0		0.1	0.0
1,1,2,2-Tetrachloroethylene	1.3		NA		0.4		0.9	0.0
Toluene	55.6	0.0	NA	0.0	6.5	0.0	31.1	0.0
Chlorobenzene	0.7	0.0	NA	0.0	0.5	0.0	0.6	0.0
Ethylbenzene	8.2	0.0	NA	0.0	1.1	0.0	4.6	0.0
Total	187.7	257.4	NA	381.6	93.7	164.9	140.7	268.0
Nonpriority Pollutants								
C_3H_4	0.0		NA		0.0		0.0	
Dimethyl ether	28.3		NA		0.5		14.4	
Dichlorodifluoromethane	0.1		NA		0.1		0.1	
Acetonitrile	0.0		NA		0.2		0.1	
C_4H_{10}	0.0		NA		0.8		0.4	
C_4H_8/Acetone	8.2	0.0	NA	6.9	6.8	18.8	7.5	8.6
Chloropropene	0.0		NA		0.6		0.3	
Bromochloromethane	0.0		NA		0.0		0.0	
Tetrahydrofuran/C_5H_{12}	2.0		NA		0.3		1.2	
C_5H_8/C_5H_{10}	0.0		NA		1.0		0.5	
C_5H_{12}/C_6H_{12}	4.1		NA		1.2		2.6	
C_6H_{12}/C_6H_{14}	10.8		NA		0.6		5.7	
$C_5H_{12}O_2$	0.0		NA		0.0		0.0	
C_6H_{12}	1.3		NA		0.0		0.6	

(continued)

TABLE 4-9. (continued)

Constituent	Concentration (as ppb methane)							
	Run 1		Run 2		Run 3		Avg. 1-3	
	MRI (VOST)	MRI (GC)	MRI (VOST)	MRI (GC)	MRI (VOST)	MRI (GC)	MRI (VOST)	MRI (GC)
Nonpriority Pollutants (continued)								
Dichloroacetonitrile	3.5		NA		0.7		2.1	
C_7H_{14}/C_6H_{12}	0.0		NA		0.7		0.3	
C_7H_{14}/C_7H_{16}	50.1		NA		2.6		26.4	
C_6H_{12}	0.0		NA		0.5		0.3	
C_7H_{14}/C_7H_{16}	7.5		NA		0.7		4.1	
Hydrocarbon	0.9		NA		0.8		0.8	
C_7H_{12}	0.0		NA		0.0		0.0	
Isooctane	9.9		NA		6.2		8.0	
Hydrocarbon	9.3		NA		1.0		5.2	
Total	135.8	0.0	NA	6.9	25.3	18.8	80.6	8.6

Constituent	Concentration (as ppb methane)							
	Run 4		Run 5		Run 6		Avg. 4-6	
	MRI (VOST)	MRI (GC)	MRI (VOST)	MRI (GC)	MRI (VOST)	MRI (GC)	MRI (VOST)	MRI (GC)
Priority Pollutants								
Methyl chloride	4.8	191.3	44.6	185.1	102.8	297.2	50.7	224.5
Methyl bromide	2.2	0.0	3.6	0.0	4.0	0.0	3.3	0.0
Vinyl chloride	1.2	2.3	3.1	7.1	4.9	4.8	3.1	4.7
Dichloromethane	2.9	0.0	133.6	45.6	80.1	13.0	72.2	19.6
Trichlorofluoromethane	0.0		0.1		0.3		0.1	0.0
1,1-Dichloromethylene	0.2	0.0	0.4	0.0	0.4	0.0	0.3	0.0
Chloroform	61.2	0.0	20.5	4.8	14.9	0.0	32.2	1.6
1,2-Dichloroethane	0.9		0.2		0.8		0.6	0.0
1,1,1-Trichloroethane	1.1	0.0	0.6	0.0	0.3	0.0	0.7	0.0
Carbon tetrachloride	4.7	0.8	7.3	0.8	2.1	0.0	4.7	0.5
Dichlorobromomethane	13.7	4.7	1.0	0.0	2.5	0.0	5.8	1.6
1,2-Dichloropropane	0.1	0.0	0.0	0.0	33.3	0.0	11.1	0.0
Trichloroethylene	0.1	0.0	0.1	0.0	0.1	0.0	0.1	0.0
Benzene	367.9	20.4	113.1	13.5	324.9	255.3	268.6	96.4
Chlorodibromomethane	4.0		0.5		0.3		1.6	0.0
2-Chloromethyl vinyl ether	3.2		6.0		1.5		3.6	0.0
Bromoform	5.4		0.5		0.1		2.0	0.0
1,1,2,2-Tetrachloroethylene	0.3		0.2		0.1		0.2	0.0
Toluene	11.7	0.0	6.4	0.0	5.1	0.0	7.7	0.0
Chlorobenzene	3.4	0.0	3.4	0.0	3.5	0.0	3.4	0.0
Ethylbenzene	6.3	0.0	1.5	0.0	0.9	0.0	2.9	0.0
Total	495.3	219.5	346.9	256.9	582.9	570.4	475.0	348.9

(continued)

TABLE 4-9. (continued)

Constituent	Concentration (as ppb methane)							
	Run 4		Run 5		Run 6		Avg. 4-6	
	MRI (VOST)	MRI (GC)	MRI (VOST)	MRI (GC)	MRI (VOST)	MRI (GC)	MRI (VOST)	MRI (GC)
Nonpriority Pollutants								
C_3H_4	1.7		0.0		3.3		1.7	
Dimethyl ether	1.5		1.4		1.6		1.5	
Dichlorodifluoromethane	0.1		0.1		0.1		0.1	
Acetonitrile	0.5		0.6		0.2		0.4	
C_4H_{10}	3.3		0.0		0.0		1.1	
C_4H_8/Acetone	14.3	0.0	9.0	22.9	9.5	5.7	10.9	9.5
Chloropropene	0.9		0.0		0.0		0.3	
Bromochloromethane	0.0		1.0		6.5		2.5	
Tetrahydrofuran/C_5H_{12}	2.5		1.2		1.5		1.7	
C_5H_8/C_5H_{10}	0.0		1.6		0.0		0.5	
C_5H_{12}/C_6H_{12}	0.0		0.5		0.5		0.3	
C_6H_{12}/C_6H_{14}	3.0		6.5		0.0		3.2	
$C_5H_{12}O_2$	0.0		0.6		3.5		1.4	
C_6H_{12}	0.0		0.6		0.0		0.2	
Dichloroacetonitrile	0.7		0.3		0.0		0.3	
C_7H_{14}/C_6H_{12}	0.0		1.5		0.0		0.5	
C_7H_{14}/C_7H_{16}	0.0		0.0		0.9		0.3	
C_6H_{12}	0.0		0.6		2.7		1.1	
C_7H_{14}/C_7H_{16}	10.1		1.6		1.7		4.5	
Hydrocarbon	0.6		0.6		0.0		0.4	
C_7H_{12}	2.5		2.5		2.2		2.4	
Isooctane	351.6		29.3		0.0		127.0	
Hydrocarbon	8.8		0.0		0.0		2.9	
Total	402.1	0.0	59.8	22.9	34.2	5.7	165.4	9.5

TABLE 4-10. TOTAL HYDROCARBON RESPONSE AND TOTAL MASS (ORGANIC) EMISSIONS

		Organics					
Run No.	THC	Methane	Ethylene	Other volatiles	Semi-volatiles	Total organics	Fraction of total (%)
1	7.6	1.7	ND	0.6	2.5	4.7	62
2	6.8	1.2	ND	0.8	1.6	3.6	53
3	6.2	1.3	ND	0.2	1.9	3.3	54
4	8.8	4.3	1.1	1.1	1.6	8.0	91
5	145	93	1.3	0.5	2.0	96.8	67
6	106	51	0.6	0.7	1.5	53.7	50

Note: All values are ppm methane (FID) equivalent, dry gas basis.

ND = not detected.

NA = not available.

Several factors must be kept in mind when comparing the THC and measured total of all organics found. First, many of the response factors are assumed values with disagreement among various literature sources about the best values. However, such factors are almost always within 20% of the actual measured values and any errors should be randomly distributed.

4.4 CHLORIDE, PARTICULATES, CYANIDE, AND METAL CONTENT

4.4.1 Particulate Matter, Cyanide, and HCl Emissions

Table 4-11 presents the particulate and HCl emissions and the HCl removal efficiency for each run. The range of particulate emissions was 9.0 to 35 mg/m³. Ash loading to the incinerator was very low compared to typical operation of this incinerator and to typical operation of other rotary kilns that burn hazardous waste. The range of HCl emissions was 0.016 to 0.038 kg/hr. HCl removal efficiencies averaged 99.98%. These rates are all very low compared to the regulatory limits and to typical results from other hazardous waste incinerator tests. No levels of cyanide ion were found in the analysis of any of the runs.

TABLE 4-11. PARTICULATE AND HCl EMISSIONS

Run	Particulate (mg/m³)	HCl emissions[a] (kg/hr)	HCl efficiency[a]
1	15.9	0.022	0.99993
2	14.2	0.016	0.99989
3	9.0	0.016	0.99990
4	11.1	0.028	0.99978
5	23.6	0.030	0.99985
6	35.5	0.038	0.99984

[a] Average of two values.

No significant difference is apparent between the normal condition runs and the transient upset runs. Although the mean particulate emissions for Runs 1 through 3 was 13 mg/m^3 and the mean for Runs 4 through 6 was 23 mg/m^3, this represents only a 28% deviation from the overall mean emission rate of 18 mg/m^3. Similarly, the mean HCl emission of 0.018 kg/hr for Runs 1 through 3 and 0.032 kg/hr for Runs 4 through 6 are only a 28% deviation from the overall mean of 0.025 kg/hr.

4.4.2 Metals Analysis

Analyses were performed for Appendix VIII metals plus copper and zinc in each of the waste feed streams for Runs 1 and 6. The results are presented in Table 4-12. Duplicate analyses were performed for samples from Run 1 but only single analyses for samples from Run 6.

In the liquid organic waste feed, the highest metal content was zinc at about 30 µg/g. Overall, the aqueous waste feed showed low metal content. Again, zinc was present in the highest concentration at a level of 2 to 3 µg/g. All other metals were less than 1 µg/g.

For the three solid wastes, the polyethylene wax generally showed the lowest levels of metals. In the substituted cellulose waste, zinc was present at about 82 µg/g in the Run 1 sample but only 9.6 µg/g for the sample from Run 6. Other metals that showed concentrations greater than 10 µg/g were copper, thallium, arsenic, selenium, antimony, and lead. The substituted polyethylene wax had zinc levels of approximately 47 µg/g; the only other metals present at concentrations greater than 10 µg/g were copper, thallium, arsenic, and selenium. The samples of the chlorinated pyridine tars showed relatively higher metal levels, particularly in the sample for Run 6. The sample from Run 1 had barium and nickel at levels of about 44 µg/g and chromium, copper, zinc, and selenium at levels greater than 10 µg/g. In the sample from Run 6, the levels of nickel and chromium were significantly higher than in any other solid samples. Nickel was present at about 1,250 µg/g and chromium at about 900 µg/g. Zinc was present at

TABLE 4-12. METAL CONCENTRATIONS IN THE WASTE FEEDS

Waste	Metal concentration (μg/g)													
	Cr	Cu	Zn	Hg	Be	Ag	Tl	As	Ba	Se	Sb	Ni	Cd	Pb
1. Liquid organic														
Run 1[a]	2.0	18.4	32.8	< 6.4	0.1	5.2	< 13.3	13.7	1.4	< 19.2	< 8.4	< 4.1	1.9	< 11.0
Run 6	2.4	16.1	28.5	< 5.0	0.1	3.0	17.1	< 10.8	1.1	< 15.1	< 6.6	< 3.2	1.8	< 8.6
2. Aqueous waste														
Run 1[a]	0.3	0.6	3.5	< 0.09	0.002	0.08	0.3	< 0.2	0.2	< 0.3	< 0.1	0.3	0.04	< 0.1
Run 6	0.03	0.2	0.7	< 0.08	0.003	0.05	0.3	< 0.2	0.5	< 0.2	< 0.1	< 0.05	0.02	< 0.1
3. Substituted cellulose														
Run 1[a]	4.8	23.0	81.7	< 7.7	0.1	4.5	< 14.5	< 16.6	5.2	< 23.3	< 10.2	< 4.9	3.9	< 13.2
Run 6	4.1	15.1	9.6	< 7.7	0.2	4.3	< 14.0	< 16.6	1.4	< 23.2	< 10.2	< 4.9	2.3	< 13.3
4. Polyethylene wax														
Run 1[a]	2.5	34.4	63.5	< 6.5	< 0.08	5.5	13.4	< 14.0	2.2	< 19.5	< 8.6	< 4.1	1.9	< 11.2
Run 6	1.4	16.6	30.6	< 4.1	< 0.07	2.3	8.3	< 8.9	1.2	< 12.5	< 5.5	< 2.6	1.5	< 7.1
5. Chlorinated pyridine tars														
Run 1[a]	16.2	19.0	25.3	< 4.3	0.1	2.2	9.5	< 9.3	44.2	< 13.0	< 5.7	43.5	1.9	< 7.4
Run 6	903	39.4	74.5	< 5.9	0.2	2.8	23.4	< 12.7	59.7	< 17.7	< 7.8	1,247	5.4	12.1

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[a] Average of duplicate analyses.

about 75 μg/g while barium levels were approximately 60 μg/g. Other metals present in this sample at levels greater than 10 μg/g were copper, thallium, arsenic, selenium, and lead. During the sampling of the drums of the chlorinated pyridine tars, a considerable inconsistency was observed in the nature of the waste between the drums. This could be a partial explanation for the differences observed between the Run 1 and 6 samples.

4.5 WASTE FEED AND SCRUBBER WATER ANALYSES

Analyses of the two waste feeds used in this study and the scrubber makeup and discharge water were performed for volatile priority pollutants. The levels of the volatile priority pollutants found in the liquid organic waste feed are shown in Table 4-13. Table 4-14 shows the levels of those volatile priority pollutants found in the aqueous waste feed.

The concentrations of the volatile priority pollutants found in the scrubber and quench makeup water and the scrubber discharge water are shown in Table 4-15.

4.6 QUALITY ASSURANCE SUMMARY

Data packets, supporting documentation, and field records were reviewed by the quality assurance coordinator with respect to quality assurance (QA) objectives as presented in the Project Quality Assurance Plan (QAP).

4.6.1 VOST and Volatile POHC Data Review

VOST and volatile POHC data packets were inspected and the results are summarized below. No major problems were found with the data chosen for auditing or with the supporting documentation data packet.

- Six VOST field blanks and two trip blanks were analyzed, as specified in the QAP. Some of the VOST sample results were blank corrected for certain analytes, and these were identified in a separate list included with the data.

TABLE 4-13. PRIORITY POLLUTANT CONCENTRATION IN LIQUID ORGANIC WASTE FEED

Compound	Concentration (ppm)[a]					
	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6
Benzene	224	ND[b]	275	323	270	217
Carbon tetrachloride[c]	10.4%	10.4%	10.3%	10.2%	10.1%	10.1%
Chlorobenzene	ND	ND	239	267	366	402
Chloroform	166	ND	505	2,600	155	1,480
Ethylbenzene	236	ND	ND	ND	ND	557
Methylene chloride	1,580	ND	1,560	243	144	366
Tetrachloroethene	528	ND	ND	ND	ND	ND
Toluene	351	ND	82	214	232	185

[a] Based on MRI analyses.

[b] ND = Not detected.

[c] Carbon tetrachloride concentrations from Dow analysis, expressed in (%) concentration.

TABLE 4-14. PRIORITY POLLUTANT CONCENTRATION IN AQUEOUS WASTE FEED

Priority pollutant	Concentration (ppm)[a]											
	Run 1		Run 2		Run 3		Run 4		Run 5		Run 6	
	MRI	DOW	MRI	DOW	MRI	DOW	MRI	DOW	MRI	DOW	MRI	DOW
Benzene	4.9	5.8	1.7	ND	1.2	ND	4.4	4.0	2.4	2.1	0.5	1.4
Carbon tetrachloride	12.4	14.3	11.0	16.1	9.0	12.7	10.6	8.6	7.3	7.2	ND	5.7
2-Chloroethylvinyl ether	6.8	ND	6.1	ND	4.8	ND	4.7	ND	3.8	ND	ND	ND
Chloroform	4.3	3.5	1.9	2.6	1.4	1.8	1.9	1.3	1.1	0.6	2.1	BDL
1,1-Dichloroethane	0.6	0.7	ND	0.5	ND	BDL	ND	BDL	ND	BDL	ND	BDL
1,1-Dichloroethene	0.8	0.6	ND	ND	ND	ND	0.4	BDL	ND	BDL	ND	BDL
1,2-Dichloropropane	1.3	1.2	ND	0.6	ND	0.4	ND	0.6	ND	0.5	ND	BDL
trans-1,3-Dichloropropene	ND	ND	ND	ND	ND	ND	0.3	ND	0.7	ND	ND	ND
Ethylbenzene	0.9	BDL	0.1	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methylene chloride	33.0	22.6	9.5	10.3	6.3	6.0	11.4	9.7	6.0	5.5	1.3	3.8
1,1,2,2-Tetrachloroethane	0.6	BDL	ND	BDL	ND	BDL	0.1	BDL	0.1	ND	ND	ND
Tetrachloroethylene	4.4	4.2	2.0	4.4	1.7	3.5	2.2	5.5	1.5	6.4	0.5	14.8
Toluene	4.5	6.1	4.0	0.5	3.3	ND	4.0	3.2	2.9	2.0	1.0	1.5
1,1,1-Trichloroethane	22.4	25.5	11.0	18.4	8.0	13.2	15.8	13.9	9.0	9.5	4.6	6.5
1,1,2-Trichloroethane	8.2	7.5	4.2	6.0	3.0	4.4	4.4	4.2	2.5	2.4	1.7	ND
Trichloroethylene	0.2	BDL	ND	1.1	ND	0.9	ND	BDL	ND	BDL	ND	1.6

[a] Limit of quantitation = 0.4 ppm (DOW).

BDL = Below detection limit.

ND = Not detected.

TABLE 4-15. PRIORITY POLLUTANT CONCENTRATIONS IN SCRUBBER WATERS

	Concentration (ng/mL)[a]					
Constituent	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6
Scrubber Makeup						
Methylene chloride	1.4	3.7	1.4	0.9	0.002	0.1
Chloroform	51.7	53.3	60.4	58.6	0.3	7.5
1,2-Dichloroethane	0.3	0.3	0.06	0.2	ND[b]	ND
1,1,1-Trichloroethane	0.06	0.8	0.2	ND	ND	ND
Bromodichloromethane	13.5	13.2	15.5	15.8	0.06	1.8
Dibromochloromethane	2.0	1.7	1.9	2.2	ND	ND
Benzene	0.1	0.6	0.1	0.02	0.04	0.01
2-Chloroethyl vinyl ether	0.2	0.2	0.05	0.1	0.2	ND
1,1,2,2-Trichloroethane	0.02	ND	0.02	ND	ND	ND
Tetrachloroethylene	0.1	0.2	0.2	ND	0.05	ND
Toluene	0.1	0.3	0.2	0.2	0.1	0.2
Ethylbenzene	0.05	0.02	0.09	ND	ND	ND
Scrubber discharge						
Methylene chloride	6.3	2.3	1.1	0.2	0.8	0.4
Chloroform	2.3	1.7	1.9	1.7	0.1	0.3
1,2-Dichloroethane	0.2	0.04	ND	ND	ND	ND
Bromodichloromethane	0.6	3.4	0.4	0.5	ND	0.1
Benzene	0.5	21.7	0.2	0.03	0.1	0.1
2-chloroethyl vinyl ether	0.3	0.07	0.2	0.5	ND	ND
Tetrachloroethylene	0.1	0.3	0.03	ND	ND	ND
Toluene	0.3	0.1	0.2	0.07	0.3	0.4
Ethylbenzene	0.04	0.1	0.04	0.07	0.1	0.1

[a] Based on MRI analyses.

[b] ND = Not detected.

- Duplicate analyses were performed on Run 3 samples. Precision values were generally better than 20% range percent deviation (RPD) for analytes detected in the scrubber water inlet, scrubber water outlet, and aqueous waste samples. A duplicate analysis of the liquid organic waste sample showed greater variability for a few of the analytes: RPDs were 146, 119, and 84% for methylene chloride, chloroform, and toluene, respectively.

- Surrogate recoveries appear generally good, with the only exceptions being the aqueous waste samples and the liquid organic waste samples, which ranged from about 48 to 75% and from about 20 to 30%, respectively.

- Laboratory records were complete and technical review was evident. Sample traceability records also appeared in good order. Some method deviations from the original test plan were made for technical reasons by the analysts to improve the analysis. These changes included the use of PEG instead of tetraglyme for dilution of the waste feed samples, and a change to an SP-1000 packed column from an originally specified DB-624 column.

- A three-point calibration curve was used to quantify most target analytes; for high-level samples, more concentrated standards were used to extend the calibration range and calculate results using a secondary ion. Quantitation procedures were summarized in a memo, "Summary of RRFs for Alternate Ions Used for Quantitation." Data reduction and validation were accomplished using computer generated spread-sheet tables and a two-level technical review by the project staff.

- Holding time requirements (14 days), for analysis of the samples appear to have been met in all cases.

- Several of the samples were selected at random for auditing by the QAC and were traced in the project records for identification, custody, preparation, and analysis; calculations were spot-checked based on the raw data, documented dilutions, and surrogate spiking levels.

4.6.2 Volatile POHC Performance Sample Results

Two GC/MS performance samples were prepared in methanol to evaluate the accuracy of the calibration standards for the VOST and volatile POHC analyses. Two other performance samples were prepared as water solutions and submitted for analysis with the field samples.

The performance samples were prepared by the QAC from standards that were independent from the project calibration standards. Results were reported back to the QAC by the analyst so that accuracy values (found result/ expected result x 100) could be determined. The results of the audit samples are presented in the table below. About 88% (46 out of 50) analytes spiked in the performance samples were within ±50% of the expected values.

	Accuracy (%)			
Analyte	Methanol 03171[a]	Methanol 03172[b]	Water 03173[c]	Water 03174[d]
Methylene chloride	85	67	83	95
Trichlorofluoromethane	90	32	28	35
1,1-Dichloroethene	96	61	58	60
1,1-Dichloroethane	115	48	78	82
Chloroform	111	37	84	85
Carbon tetrachloride	128	89	67	63
1,2-Dichloropropane	109	90	84	89
Trichloroethene	95	81	78	79
Dibromochloromethane	128	75	122	106
1,1,2-Trichloroethane	108	89	89	91
2-Chloroethyl vinyl ether	32	83	105	107
Tetrachloroethene	107	91	70	69
Chlorobenzene	108	89	87	89

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[a] Concentration was 100 ng/μL methanol for each analyte.

[b] Concentration was 57.1 ng/μL methanol for each analyte.

[c] Concentration was 50 ng/mL water for each analyte.

[d] Concentration was 30 ng/mL water for each analyte.

4.6.3 VOST Performance Audit Sample Results

Two EPA audit cylinders were sampled by MRI and Dow Chemical in the field using the VOST method. The cylinders were also analyzed by GC-Hall and GC-PID in the field. Results of the VOST trap analysis by both MRI and Dow chemical as well as the results of the GC analyses were provided to the QAC by the work assignment leader and field team leader and are presented in Table 4-16. Nearly all of the MRI and Dow VOST results were higher than the EPA value. The only exception was the result by Dow for vinyl chloride. The MRI VOST results were higher than those by Dow for most compounds. The field GC results were typically lower than the MRI or Dow VOST results except for toluene and benzene.

TABLE 4-16. RESULTS OF VOST AUDIT SAMPLES ANALYSES

Cylinder No.: AAL 15162

Analyte reported	EPA value (ppb)	VOST (MRI)		VOST (DOW)		GC-Hall		GC-PID	
		Found (ppb)	Accuracy (%)	Found (ppb)	Accuracy (%)	Found (ppb)	Accuracy (%)	Found (ppb)	Accuracy (%)
Vinylidene chloride	8.5	15.2	179	9.1	107	6.1	72	NA	-
Toluene	10.5	16.5	157	16.8	160	NA	-	19.7	188
Chlorobenzene	10.8	15.9	147	16.9	156	NA	-	6.8	63

Cylinder No.: AAL 11948

Analyte reported	EPA value (ppb)	VOST (MRI)		VOST (DOW)		GC-Hall		GC-PID	
		Found (ppb)	Accuracy (%)	Found (ppb)	Accuracy (%)	Found (ppb)	Accuracy (%)	Found (ppb)	Accuracy (%)
Carbon tetrachloride	9.6	20.0	208	13	135	7.5	78	NA	-
Chloroform	37.1	62.8	169	40.1	108	35.6	96	NA	-
1,1,2,2-Tetrachloroethylene	9.1	14.6	160	13	143	NA	-	NA	-
Benzene	19.4	26.0	134	21.4	110	NA	-	22.2	114
Vinyl chloride	20.4	34.1	167	9.43	46	18.5	91	NA	-

NA = Not available.

SECTION 5.0

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APPENDIX A

SAMPLING AND ANALYSIS PROCEDURES

This appendix is divided into two sections: Sampling Procedures (Section A-1) and Analytical Procedures (Section A-2). The sampling procedures section details the methods for Modified Method 5 (MM5), volatile organic sampling train (VOST), total hydrocarbons (THC), field gas chromatographs (PID, Hall, FID), continuous gas monitors, aldehydes, and waste feeds. The analytical procedures section details the methods used in the quantitation of volatile compounds, semivolatile compounds, aldehydes, metals, and chlorides.

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A-1 - SAMPLING PROCEDURES

MODIFIED METHOD 5

Two identical sampling trains were used as shown in Figure A-1. The trains follow the EPA SW-846 manual design including nickel nozzles, Pyrex probe liners, Pyrex/Teflon filter holder, condenser and XAD cartridge, and Ace Glass threaded greaseless joints with an added impinger containing 0.1M sodium carbonate to ensure collection of HCl. During sample recovery the trains were rinsed with acetone followed by hexane. After reviewing each test run, one train was analyzed for particulates and the other was analyzed for semivolatile organics. If minor problems, such as small glass fragments on the filter, occurred during the test, the alternate train was used for semivolatiles. A small aliquot of the impinger condensate as well as the alkaline impinger contents were analyzed for chlorides using ion chromatography. The sampling procedure basically follows those described in a draft test protocol (September 18, 1984) prepared by the American Society of Mechanical Engineers entitled "Sampling for the Determination of Chlorinated Organic Compounds in Stack Emissions." MRI standard operating procedures (SOPs) for the MM5 trains have been outlined in the QA Plan.

VOST

Three 40-min pairs of VOST traps were collected during each run using an MRI-designed third generation train which uses compression-loaded 0.625-in. Pyrex tubes and Cajon Ultra-Torr end fittings of the same diameter. One pair of field blank traps (unsealed on stack for duration similar to the sample trap handling necessary to install and remove from the train) were also collected for each run. Unopened trip blanks were also used. The operating procedure conforms to the procedures recommended in Protocol for the Collection and Analysis of Volatile POHCs Using VOST (EPA-600/8-84-007).

Simultaneous VOST sampling was also conducted by Dow Chemical using a Neutech-style sampling train.

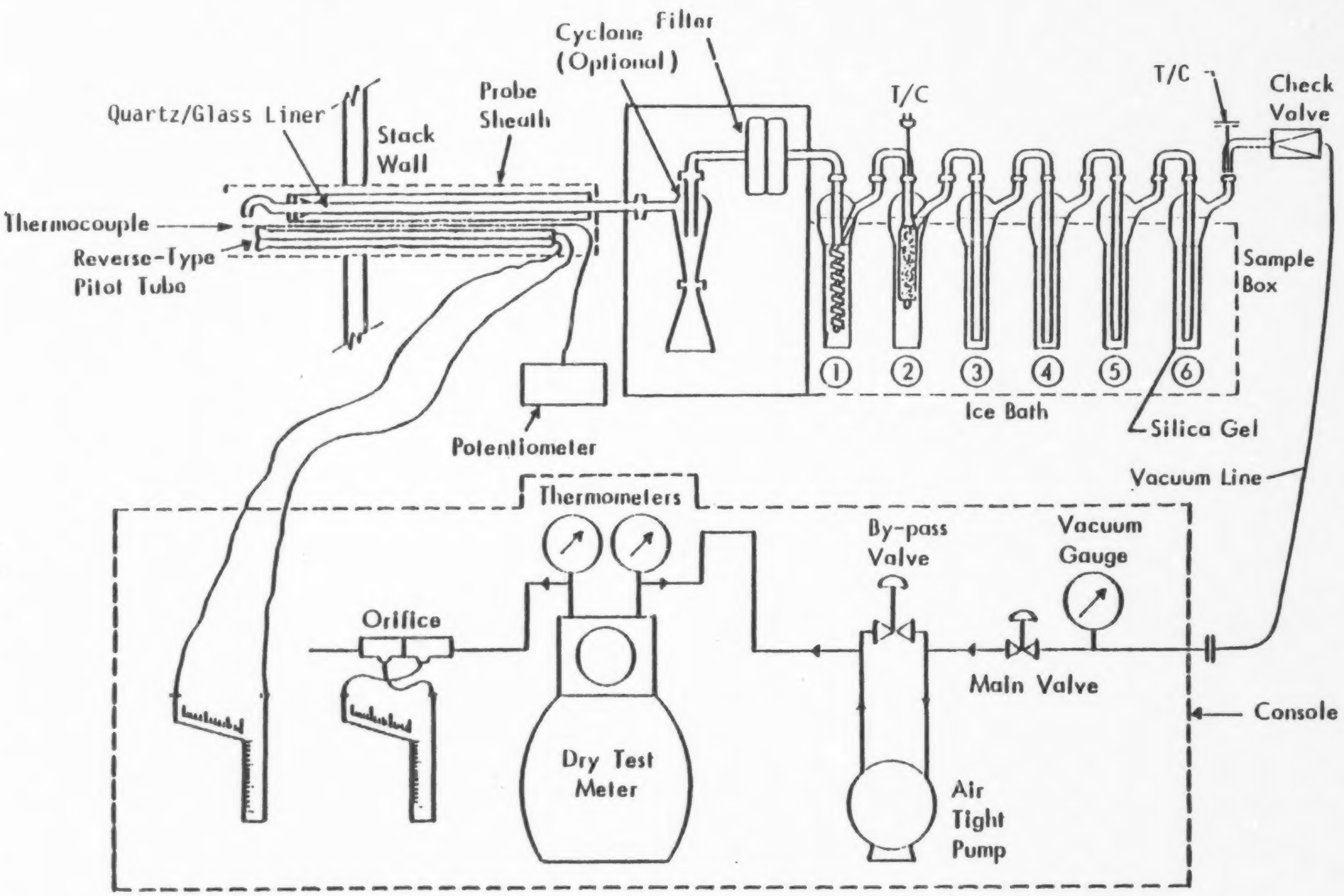
TOTAL HYDROCARBONS

MRI used a Beckman 402 total hydrocarbon (THC) analyzer to measure the continuous THC content of the stack. The collection and transportation system maintained the gas stream at a minimum temperature of 120°C to prevent condensation losses. This temperature was well above that of the stack gas. The data were recorded on a strip chart recorder with manual 1-min average readings. The calibration gas was 10.2 ppm propane in air with later comparison to a methane standard for determining methane equivalent response.

Dow Chemical also had a THC process analyzer connected to the stack which used an unheated sampling line. Both analyzers use a flame ionization detector (FID).

FIELD GC, PID, AND HALL DETECTORS

MRI operated an on-site GC with an HNU photoionization detector (PID) with 10.2-ev lamp to measure aromatic compounds as well as certain unsaturated organics of interest such as vinyl chloride. The separation column


Quartz/Glass Liner
Stack Wall
Probe Sheath
Cyclone (Optional)
Filter
T/C
T/C
Check Valve
Thermocouple
Reverse-Type Pitot Tube
Sample Box
① ② ③ ④ ⑤ ⑥
Ice Bath
Silica Gel
Potentiometer
Vacuum Line
Thermometers
By-pass Valve
Vacuum Gauge
Orifice
Main Valve
Console
Dry Test Meter
Air Tight Pump

① Condenser with Ice Water Jacket
② XAD Resin Cartridge with Ice Water Jacket
③ Modified Greenburg-Smith, 50 mL of Double Distilled in Glass H_2O
④ Modified Greenburg-Smith, 50 mL of Double Distilled in Glass H_2O
⑤ Greenburg-Smith, 100 mL 0.1 N KOH
⑥ Modified Greenburg-Smith, SiO_2

Figure A-1. Diagram of MM5 train.

used was a J&W 30-m DB-624 megabore column in a temperature programmed oven. The instrument was fitted with a heated Carle gas sampling valve with matched 1-mL gas sampling loops. The sampling valve was connected to the pressurized exit of the THC analyzer pump via a 20-ft section of unheated Teflon tubing. A water knockout trap was used to remove moisture from the gas stream.

MRI also operated an on-site GC fitted with a Tracor Hall detector. A 1% SP-1000 on Carbopack B column (same as used in EPA Method 624) was operated in the temperature programmed mode to separate the purgeable halogenated organics. Samples were taken by gas-tight syringe from a septum port installed after the water knockout trap in the Teflon line which supplied gas to the field PID chromatograph.

The choice of the Hall and PID was made to obtain adequate detection (about 10 ppb) for the volatile aromatic and halogenated organics commonly analyzed by EPA Method 624. Each detector has good selectivity and sensitivity for its respective target compounds. In combination they cover the entire Method 624 list with minimal uncertainty in identification, since only a few of the compounds co-elute. The detectors' selectivity rejects most possible interfering compounds. While the sensitivity is not as great as that obtained from an integrated VOST sample analyzed by GC/MS, both detectors are far better quantitative instruments than a mass spectrometer.

FIELD GC, LIGHT HYDROCARBONS

Acurex operated an on-site GC with FID for measurement of light hydrocarbons. A Porapak QS column operated isothermally was used to separate the methane through propane series of hydrocarbons. Samples of stack gas were injected by gas-tight syringe. The samples were taken from a gas conditioning system located in the EPA Mobile Laboratory.

CARBON MONOXIDE

Acurex and Dow both operated nondispersive infrared (NDIR) instruments to measure carbon monoxide similar to the continuous option in EPA Method 10. Data were logged at least once every minute by both instruments.

OTHER GASES

Acurex also operated continuous gas analyzers for oxygen, carbon dioxide, and nitrogen oxides from the EPA monitoring van. Data were averaged at 30-sec intervals. MRI also collected an integrated Orsat sample for use in measuring gas molecular weight for the MM5 train isokinetic sampling. Standard procedures from USEPA 40 CFR 60, Appendix A, Reference Method 3 were followed.

ALDEHYDES

MRI used a midget impinger train with dinitrophenyl hydrazone (DNPH) to collect aldehydes, especially formaldehyde. The samples were later analyzed by liquid chromatography according to EPA Method A132.

SOLID WASTE FEEDS

Samples were collected by first removing the top 1/2 in. of material from area to be sampled. Subsamples were then collected with a trowel such that a composite sample size of 1 kg was obtained for each test run. One subsample was collected from every other solid waste container except all drums containing chlorinated pyridine tars. The sample jars were appropriately labeled and packed in a cooler with ice for transfer to the laboratory.

LIQUID WASTE FEEDS

Composite samples and VOA samples were obtained for both the liquid organic and aqueous waste feeds. Liquid organic samples for each test consisted of a 1-qt composite and a single composite VOA taken from the 1-qt composite upon completion of the run. Aqueous waste samples consisted of a 1-gal. composite, VOA samples taken every 15 min during a run, and a single composite VOA sample obtained from the 1-gal. composite upon completion of the run. Sampling procedures are outlined below.

COMPOSITE SAMPLES

1. The volume of each aliquot collected for the composite sample is predetermined according to the test plan. The sample bottle is marked to indicate equal portions depending upon the number of aliquots collected. The sample bottle is prelabeled with the appropriate sample label.

2. Open the tap carefully and flush the line into a sample collection beaker. Discard any material collected in a safe manner according to plant regulations. During this flushing process of the sample line, coordinate with plant personnel to determine if opening the tap might result in sufficient pressure drop to activate any automatic shutdown systems.

3. Again, open the tap very slowly and adjust the flow to collect the desired volume of the composite sample directly into the sample bottle; fill to the appropriate mark. The time of collection for each aliquot should be entered on the data sheet. Cap the sample bottle tightly after each aliquot is collected.

4. After collecting the final aliquot of the composite sample, cap the sample bottle tightly. Clean the outside of the sample bottle and check the sample to confirm proper identification and collection information. Cover the label with transparent tape. Tape the sample cap closed. Double-bag each sample.

5. Complete the proper sample traceability forms.

6. Pack samples in shock-resistant wrap. Place in cooler with ice.

VOLATILE ORGANIC ANALYSIS (VOA) SAMPLES

1. Prelabeled 40-mL VOA vials are used for sample collection. The number of VOA vials required is determined by the sampling frequency and the length of the test. A separate VOA vial is used for each sampling interval (i.e., each grab sample).

2. Open the tap carefully and flush the line into a sample collection beaker. Discard any material collected in a safe manner according to plant regulations. During this flushing process of the sample line, coordinate with plant personnel to determine if opening the tap might result in sufficient pressure drop to activate any automatic shutdown systems.

3. Again, open the tap very slowly and adjust the flow directly into the VOA vial. Fill the VOA completely so that no air bubbles are present when the Teflon septum caps are placed onto the vial. Assure that the Teflon side of the septum is placed against the liquid.

4. The time of collection for each VOA vial is entered on the data sheet.

5. Clean the outside of each VOA vial and check to assure each vial is appropriately labeled with proper identification and collection information. Cover the label with transparent tape. Seal the cap with Teflon tape.

6. Complete the proper sample traceability forms.

7. Pack the samples in shock-resistant wrap. Double-bag and place in a cooler with ice.

A-2 - ANALYTICAL PROCEDURES

1.0 GLASSWARE CLEANING AND PREPARATION

1.1 GLASSWARE (MAJOR ITEMS) NEEDED FOR FIELD SAMPLING

The glassware prepared for use by the field sampling crew included the following.

1.1.1 One-quart or 1-gal. wide-mouth jars with Teflon-lined caps (collection of nonliquid waste samples and bottom ash samples).

1.1.2 One-quart narrow-mouth amber glass bottles with Teflon-lined caps (collection of liquid waste samples).

1.1.3 Forty-milliliter VOA vials (collection of duplicate aqueous samples for analysis of volatile organic compounds and collection of duplicate integrated waste feed samples).

1.1.4 One-gallon narrow-mouth amber glass bottles with Teflon-lined caps (collection of aqueous samples).

1.1.5 Sixteen-ounce wide-mouth jars (collection of particulate filters).

1.1.6 XAD-adsorbent traps.

These items were prepared by the Environmental Chemistry Section and supplied to the sampling personnel prior to the burn. The actual number required was specified by the field sampling crew chief.

1.2 GLASSWARE CLEANING

Slightly different techniques were required for preparation of glassware for sampling and analysis of volatile versus semivolatile organic compounds.

1.2.1 Glassware for Field Sampling and Analysis of Volatile Organic Compounds

Manufacturer-precleaned VOA vials were used.

1.2.2 Glassware for Field Sampling and Analysis of Semivolatile Organic Compounds

1.2.2.1 All glassware was washed in hot, soapy water (ISOCLEAN nonionic soap, Micro, Alconox, or equivalent, and a clean brush).

1.2.2.2 Rinsed with tapwater (5X), deionized water (3X), and bulk acetone (2X).

1.2.2.3 Air dried and the open ends covered with solvent-rinsed aluminum foil before storage.

1.2.2.4 Any glassware that gave an indication of still being dirty, i.e., the water and acetone rinses do not "sheet," were recleaned by soaking in concentrated sulfuric acid overnight, then rinsed as in Section 1.2.2.2.

1.2.2.5 Before actual use, clean glassware and Teflon liners from storage drawers were rinsed with high purity acetone followed by a 2X rinse with the appropriate solvent to be used in the method. Glassware for field sampling was rinsed a final time with methylene chloride.

1.2.2.6 Glassware used for extraction, concentration, and cleanup procedures are numbered as a set. Such glassware was used in sets.

1.2.2.7 A final rinse of the glassware sets with the appropriate solvent was collected in a vial, labeled to note glassware type and set, and archived as a glassware rinse.

1.2.2.8 The dram vials, reacti-vials, and autosampler vials were rinsed 2X with the solvent to be used and allowed to air dry.

1.2.2.9 When required, dram vials were precalibrated by dispersing a measured volume of the appropriate solvent into the vial and etching the glass at the bottom of the miniscus. Precalibrated vials were to be rerinsed with the appropriate solvent and allowed to dry.

1.2.2.10 Vial caps were lined with solvent-rinsed Teflon liners.

1.2.2.11 After use, glassware was rinsed once with extraction solvent and once with bulk acetone before detergent washing.

2.0 SORBENT CLEANUP AND PREPARATION

Two types of adsorbents were used for collection of organics. XAD-2 was used to collect semivolatiles in the MM5 sampling train. Tenax and Tenax/charcoal were used to collect volatiles in the volatile organic sampling train.

2.1 XAD-2 CLEANUP AND CARTRIDGE PREPARATION

2.2.1 Extraction and Fluidation

A batch of XAD-2 adsorbent (Alltech Associates/Applied Science, 20/50 mesh, 90 A pore size, preextracted for EPA extraction method) was placed into a Soxhlet extraction apparatus and extracted for 16 to 22 hr with methylene chloride (DCM) as outlined in Section 2.3.2.

The XAD-2 was then placed into an evaporating dish lined with methylene chloride-rinsed aluminum foil, placed in a hood, and dried for 12 hr. The evaporating dish was lined with aluminum foil to prevent possible contamination of the XAD-2 resin from the dish. Pre-rinsed aluminum foil was placed over the XAD-2 to keep particulate matter from falling into the evaporating dish during drying.

Glass wool (preextracted with DCM as outlined in Section 2.4.1) was placed in the bottom of a 1-L continuous extraction column. The XAD-2 adsorbent was next placed into the column (~ 1,000 g/extraction column). A stream of high purity (5-9) tank nitrogen was passed for 16 hr through a bed of 50% activated carbon 50% molecular sieve and then into the extraction column. The hydrocarbon (activated charcoal) trap consists of an 8- x 1-1/2-in. stainless steel case with stainless steel frits on the inlet and outlet. All lines connecting the N_2 tank to the column are Teflon.

2.1.2 Storage of Extracted XAD-2

Precleaned XAD-2 resin not to be used immediately (within 2 weeks) was stored under high purity methanol.

2.1.3 Packing the XAD Cartridge

Dry method: A wad of glass wool (preextracted with methylene chloride) was placed into the bottom of a precleaned XAD-2 cartridge. The XAD cartridge was packed just prior to use in the field (not to extend longer than 2 weeks prior to use). XAD-2 resin was added to fill the cartridge to the top of the curved section. Glass wool (preextracted) was added into the top of the cartridge to ensure the resin will not leak out.

2.2 TENAX AND TENAX/CHARCOAL CLEANUP AND TRAP PREPARATION

Tenax and Tenax/charcoal traps used for VOST analysis were prepared by Field Programs staff.

2.3 CLEANUP AND PREPARATION OF ADSORBENTS USED IN THE ANALYTICAL PROCEDURES

2.3.1 The following adsorbents were extracted in the giant Soxhlet extractor.

- Na_2SO_4 (anhydrous, granular, Fisher Scientific, or equivalent)

2.3.2 Soxhlet Extraction Procedure for the 12-L Giant Soxhlet

2.3.2.1 The Soxhlet was charged by adding 6 L DCM in the 12-L round bottom flask.

2.3.2.2 Boiling chips (silicon carbide) were added to the 12-L round bottom flask.

2.3.2.3 Preextracted regular glass wool was placed in bottom of Soxhlet extractor to prevent adsorbents from entering into the Soxhlet arm; the adsorbent was added and wet with 1 L DCM.

2.3.2.4 Samples were extracted overnight 16-22 hr at a turnover rate of 2 cycles/hr.

2.3.2.5 The adsorbent was removed from the extractor and air dried in methylene chloride-rinsed aluminum foil-lined evaporating dishes until solvent odor was no longer detected (~ 4 hr).

2.3.3 Adsorbent Activation Procedure

2.3.3.1 Na_2SO_4--
Air-dried Na_2SO_4 was transferred to small evaporating dishes and heated in a muffle furnace at 400°C for 4 hr.

The Na_2SO_4 was stored in a clean glass jar covered with methylene chloride-rinsed foil in an oven at 130°C.

2.4 CLEANUP AND PREPARATION OF GLASS WOOL, BOILING CHIPS, AND PEG-400

2.4.1 Glass Wool (soxhlet extraction)

2.4.1.1 Approximately 6 L of methylene chloride was added to a 12-L round bottom flask. Boiling chips (silicon carbide) were added to the 12-L round bottom flask.

2.4.1.2 Regular or silanized glass wool was placed in Soxhlet and wet with 1 L methylene chloride.

The wool was extracted overnight 16-22 hr at a rate of 2 cycles/hr, air dried on methylene chloride-rinsed aluminum foil, and stored in clean glass jars with Teflon-lined screw cap.

2.4.2 Boiling Chips

2.4.2.1 Silicon Carbide Boiling Chips (Soxhlet extraction)--

2.4.2.1.1 Approximately 500 mL of methylene chloride was added to a 1-L round bottom flask. Boiling chips (silicon carbide) were added to the round bottom flask.

2.4.2.1.2 Preextracted regular glass wool was placed in the bottom of 71/60 Soxhlet. Silicon carbide boiling chips to be extracted were added and wet with approximately 200 mL of methylene chloride.

The chips were extracted overnight, 16-22 hr, air dried on methylene chloride-rinsed aluminum foil, and stored in a clean class jar with a Teflon-lined lid.

2.4.2.2 Berl Saddle Boiling Chips--

2.4.2.2.1 Berl saddles were crushed to small pieces and stored in a methylene chloride-rinsed vial or jar with Teflon-lined lid.

2.4.3 PEG-400

2.4.3.1 PEG-400 was degassed on a rotary evaporator (< 10 mm Hg) for 6 hr (see Section 6.1.2.1).

2.4.3.2 The cleaned PEG-400 was stored in the original glass container in a room free of volatile organic compounds.

3.0 EXTRACTION OF FIELD SAMPLES FOR SEMIVOLATILE ORGANIC COMPOUNDS

3.1 SAMPLE TRAIN

The components of the Modified Method 5 (MM5) sampling train that were extracted are the:

- Particulate filter/front half rinse residue
- XAD-2 resin/back half
- Condensate water

The extracts from the sampling train components (XAD-2 resin/back half rinse, filter/front half rinse, and condensate) were combined into a single extract for analysis as described below.

3.1.1 Extraction of Air Particulate Filters/Front Half Rinse Residues

The air particulate filters were Soxhlet extracted with methylene chloride (DCM).

3.1.1.1 A $ 55/50 Soxhlet extraction apparatus was assembled with 200 mL of the appropriate solvent in a 500-mL round bottom flask along with several silicon carbide boiling chips. Identification numbers of glassware and lot numbers of solvent were recroded in lab record book (LRB). The glassware rinses were collected and archived.

3.1.1.2 Preextracted regular glass wool was placed in the bottom of the Soxhlet extractor to prevent particulates from entering the Soxhlet arm. The filter was carefully folded in half, not allowing any particulate material to be lost from the filter.

3.1.1.3 The sample was added to the soxhlet extractor with tweezers being careful not to allow any particulate material to be lost from the filter. The sample container was rinsed with three 5-mL portions of methylene chloride.

3.1.1.4 Particulate present in the front half rinse of some samples was rinsed through a glass fiber filter. The rinse was collected in a clean amber bottle and the filter was added to the Soxhlet.

3.1.1.5 The sample was spiked with the method internal standard (surrogate) compound solution (refer to Table A-1).

3.1.1.6 The filter/front half residue sample was Soxhlet extracted for at least 16 hr at a turnover rate of 3 cycles/hr.

TABLE A-1. INTERNAL STANDARD COMPOUNDS

Recovery Internal Standards

D_{10}-Anthracene (B/N)
1-Fluoronaphthalene (B/N)
Pentafluorophenol (acids)
4,4'-Dibromobiphenyl (acids)

Method Internal Standards

D_8-Naphthalene (B/N)
D_{10}-Phenanthrene (B/N)
Decafluorobiphenyl (B/N)
2-Fluorophenol (acids)
2,4,6-Tribromophenol (acids)

3.1.1.7 The solvent extract was drained back into the receiving flask and saved for combining with the XAD-2 resin extracts and front half rinses.

3.1.2 Extraction of XAD-2 Resin

The MM5 sampling train contained an XAD-2 resin cartridge containing ~ 65 g of XAD-2 resin. The cartridge was extremely wet because stack gas condensate passed through it during sampling.

3.1.2.1 A \$ 71/60 Soxhlet extractor was assembled with a \$ 29/42 joint attached to a 1,000-mL round bottom flask containing 600 mL of methylene chloride and several silicon carbide boiling chips. The identification numbers of the glassware and the lot numbers of the solvent in the LRB were recorded. The glassware rinses were collected and archived.

3.1.2.2 The XAD-2 resin from each collection cartridge was added to the Soxhlet extractor. Preextracted regular glass wool was used to hold the XAD-2 resin in the Soxhlet extractor.

3.1.2.3 The XAD-2 resin was spiked with the appropriate method internal standard (surrogate) solution.

3.1.2.4 The resin was Soxhlet extracted for at least 16 hr at a turnover rate of 3 cycles/hr.

3.1.2.5 The solvent extract was drained back into the round bottom flask and saved for combining with the filter extracts.

3.1.3 Extraction of MM5 Train Condensate

Each of the aqueous samples were extracted with methylene chloride according to EPA Method 625 using the techniques described below.

3.1.3.1 Separatory Funnel Extraction--

This method covers the extraction using standard separatory funnel techniques.

3.1.3.1.1 The glassware identification numbers were recorded in the LRB.

3.1.3.1.2 The apparatus was rinsed with methylene chloride and the rinse was archived for contamination check, if required.

3.1.3.1.3 The liquid sample was extracted in a 1,000-mL separatory funnel. The water meniscus was marked on the side of the sample container for later determination of sample volume. The entire sample was poured into the separatory funnel. The volume of each sample was recorded in the LRB.

3.1.3.1.4 The method internal standard spiking solution was added to the sample and gently swirled.

3.1.3.1.5 Methylene chloride (60 mL) was added to the sample bottle followed by shaking 30 sec to rinse the walls. The lot number of solvent was recorded LRB.

3.1.3.1.6 The solvent was transferred to the separatory funnel and the sample was extracted by vigorously shaking the funnel for 2 min with an occasional venting to release excess pressure.

3.1.3.1.7 The organic layer was allowed to separate from the water phase.

3.1.3.1.8 The methylene chloride extract was collected in a 1-L bottle and the extraction procedure (4.1.3.1.5-4.1.3.1.7) repeated two more times. The three fractions were combined in preparation for the procedures outlined in Section 5.3.

3.1.3.1.9 At least one spiked method blank which consisted of 1,000 mL of Milli-Q water was spiked with the method internal standard and extracted in the same manner as the sample.

4.0 CONCENTRATION AND COLUMN CLEANUP FOR SEMIVOLATILE ORGANIC COMPOUNDS

Each of the sample extracts from the various extraction procedures were concentrated for GC/MS analysis. The procedure below was followed.

4.1 K-D CONCENTRATION OF EXTRACTED SAMPLES

4.1.1 A small plug of preextracted silanized glass wool was placed in a fluted glass funnel and filled approximately 1/3 full with preextracted anhydrous sodium sulfate.

4.1.2 The sample extract was transferred from original extract container via the funnel to a 500-mL K-D flask equipped with a 10-25 mL graduated concentrator tube containing two clean boiling chips (crushed Berl Saddles).

Since the volume of sample extract from the extraction procedures was usually more than a 500-mL K-D flask could hold at one time, several transfers of the sample from the extract container to the K-D flask were necessary.

4.1.3 A three-ball Snyder column was attached to the K-D flask and wet down with about 1 mL of the methylene chloride.

4.1.4 The K-D apparatus was placed on a steam bath so that the concentrator tube is partially immersed in the water and the entire lower rounded surface of the flask is bathed with steam. The vertical position of the apparatus was adjusted as required to sustain a steady rate of evaporation.

4.1.5 When all of the contents of the original extract container had been added to the K-D flask, the container was rinsed (3x) with the appropriate solvent, and the rinses were added to the K-D flask via the funnel.

4.1.6 The sample extract was concentrated to a 5-10 mL volume.

4.1.6.1 Analysis for Other Semivolatile Organic Compounds--

4.1.6.1.1 The extract was concentrated to 1.0 mL using a very gentle N_2 stream. The sample was transferred to a premarked (1.0 mL) methylene chloride rinsed 4 dram vial and the K-D receiver was rinsed (3x) with methylene chloride. The rinses were added to the sample extract before concentrating under gentle N_2 stream to a final volume of 1.0 mL in methylene chloride. See Section 5.3: N_2 Concentration of Sample Extracts.

4.2 N_2 CONCENTRATION OF SAMPLE EXTRACTS

4.2.1 The disposable pipets used as needles for the N_2 evaporator were rinsed with methylene chloride.

4.2.2 The N_2 stream was adjusted so that gentle waves are seen on the solvent surface. The extracts were concentrated to 1 mL.

5.0 PREPARATION OF EXTRACTS OF WASTE FEED SAMPLES FOR ANALYSIS OF VOLATILE ORGANIC COMPOUNDS, INCLUDING POHCs

Waste feed samples are prepared as solutions (or suspensions) in PEG-400. PEG-400 is a good solvent for many organic compounds and is also soluble in water. At the same time, PEG-400 has a low vapor pressure at room temperature and is not purged out of an aqueous solution. Thus an aliquot of the sample extract in PEG-400 can be added to water immediately prior to purge-and-trap analysis of the sample by GC with MS or other detection equipment.

5.1 REAGENTS

5.1.1 Reagent Water

Reagent water is defined as a water in which interfering compounds are not observed at the method detection limit of the compounds of interest.

Reagent water was prepared by heating Milli-Q water to approximately 50°C and bubbling charcoal-purified N_2 through the water for at least 12 hr.

5.1.2 Reagent PEG-400

Reagent PEG-400 is defined as PEG-400 in which interfering compounds are not observed at the method detection limit for compounds of interest.

5.1.2.1 PEG-400 (Polyethylene glycol, average MW = 400, Aldrich 20, 239-8 or equivalent) was purified by treatment at reduced pressure in a rotary evaporator for approximately 6 hr.

5.1.2.2 In order to demonstrate that all interfering volatiles were removed from the PEG-400, a reagent PEG-400 blank was analyzed.

5.2 LIQUIDS, SOLIDS, AND SLURRIES (PEG-400)

The transfer of an aliquot of the sample for extraction with PEG-400 was made as quickly as possible to minimize loss of volatiles from the sample.

5.2.1 To a 50-mL glass culture bottle with Teflon-lined cap, 40 mL of reagent PEG-400 was added. The capped bottle and PEG-400 was weighed on an analytical balance accurate to ± 0.005 g.

5.2.2 Approximately 2 g of sample was transferred to the PEG-400 in the bottle in such a fashion that the sample was dissolved in or dispersed in the PEG-400 as quickly as possible. The bottle of PEG-400 extract was immediately recapped and weighed on an analytical balance to determine an accurate sample weight.

5.2.3 An appropriate volume of method internal standard (surrogate) was added to each sample extract.

5.2.4 The sample was dispersed by vigorous agitation for 1 min. The bottle was capped tightly and the mixture was allowed to stand until a clear supernatant was obtained as the sample extract.

5.2.5 Appropriate dilutions of the sample extracts were made to bring the concentration of analytes into working range of the GC/MS system. This was accomplished using syringes, volumetric glassware, and reagent PEG-400.

5.2.6 The sample extract was stored at -10 to -20°C and protected from light.

6.0 PREPARATION AND USE OF CALIBRATION STANDARDS, METHOD INTERNAL STANDARDS (SURROGATES), AND RECOVERY INTERNAL STANDARDS

Recovery internal standards were compounds added to the native sample matrix just prior to GC/MS analysis to determine the recovery of method internal standards and relative response factors of the calibration standards. Method internal standards (surrogates) are compounds added to the native sample matrix prior to sample extraction to determine if any sample matrix effects and extraction problems prevent good recovery of the compounds from the sample. These standards may give an indication of problems in recovering sample POHCs.

6.1 GENERAL PROCEDURES FOR STANDARD PREPARATION

6.1.1 Preparation and/or acquisition of accurate calibration standards, method internal standards, and recovery internal standards are extremely crucial in achieving accurate quantification of sample components. It is also important that the standards be prepared in the correct solvent, since the standards are both used for direct analysis and for spiking.

6.1.2 As many as possible of the pure compounds and diluted calibration standards were obtained from the EPA Quality Assurance Branch, EMSL/CI, and the Reference Standards Repository EPA/RTP.

6.1.3 The source, lot number, and purity of all standards were recorded in the LRB. All standard solutions contained the following information on its respective vial:

- Concentration of standard
- Date of preparation
- Solvent used
- Project number of sample I.D.
- Initials of person preparing solution
- Expiration date of solution

6.1.4 Stock solutions of the various calibration isomers and mixtures were prepared in a glovebox. All standards were weighed on an analytical balance.

6.1.4.1 Calibrate the analytical balance prior to weighing standards by using weights which are in the range of the standard weighings (see Figure A-2). Preparation of stock standards from primary standards were recorded on this format. A copy of this record is kept on file.

PRIMARY STANDARD DILUTION RECORD

No. ____________

Compound ____________________ Lot No. __________ Purity ____________

Final Wt. __________ g ________________ Solvent

Tare Wt. __________ g ________________ Solvent Lot No.

Std. Wt. __________ g ________________ Dilution Volume

Total mg __________ mg ________________ Final Concentration

	STANDARD Weight Before	STANDARD Weight After
________	______________ g	______________ g
________	______________ g	______________ g
________	______________ g	______________ g
________	______________ g	______________ g
________	______________ g	______________ g

Comments:

____

____

____

____

Standard Weighed by: ____________________ Date: ______________

Calculations Checked by: _________________ Date ______________

Figure A-2. Primary standard dilution record.

6.1.4.2 The various standard solutions were stored at 4°C in a Teflon-lined screw-cap vial with the solution level marked on the vial.

6.1.4.3 Dilutions of the working standard solutions were prepared from aliquots of the stock standards (see Figure A-3). Preparation of final working solutions were recorded and dilution records maintained by using this format. A copy is kept on file.

6.2 STANDARDS USED IN THE ANALYSIS OF VOLATILE ORGANIC COMPOUNDS

Calibration standards were prepared from commercially mixed stock solutions containing the compounds listed in EPA Method 624. Appropriate dilutions in methanol were made using volumetric glassware and syringes to generate a standard curve.

6.2.1 Method Internal Standards (Surrogates)

Surrogate compounds were added to samples for purge-and-trap analysis to assess the effect of the sample matrix on recovery efficiency. Surrogate compounds were also included in calibration standards.

6.2.2 Recovery Internal Standards

In this method, recovery internal standards were employed during GC/MS analysis of all samples and during all calibration procedures.

PREPARATION OF STANDARD SOLUTION

I.D. No.________ Solvent Lot No.__________ N.B. Reference ________

Project No._____ Storage Conditions ______ Expiration Date _______

	Compound	Parent Sol. Number	Conc. of Parent Sol.	Aliq. Vol. (mL)	Dilution Vol. (mL)	Dilution Solvent	Final Conc.
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							
9.							
10.							
11.							
12.							
13.							
14.							
15.							
16.							
17.							
18.							
19.							
20.							

Comments:

Prepared by:______________________ Date:______________

Checked by:______________________ Date:______________

Figure A-3. Preparation of final working standard solutions.

7.0 GC/MS ANALYSIS OF WASTE FEED, AQUEOUS, AND VOST TRAPS FOR VOLATILE ORGANIC COMPOUNDS

7.1 GC/MS ANALYSIS OF WASTE FEED SAMPLES FOR VOLATILES

Waste feed samples prepared in PEG-400 solutions and PEG-400 blanks were analyzed for volatile compounds by adding an aliquot of the diluted extract to reagent water and then carrying out purge-and-trap analyses using GC/MS (essentially EPA Method 624) according to the procedure described below. Complete details of the analysis are given in Method 624, Federal Register, October 26, 1984 (49 FR 43234).

7.1.1 The mass spectrometer was calibrated to ensure that EPA-specified tuning criteria are met for BFB and that m/z 84 for 100 ng of D_6-benzene yields about 100,000 area counts ± 50% for analysis of a reagent water method blank.

7.1.2 Reagent water (5.0 mL) was added to the purging device.

7.1.3 The water was spiked with the internal standards (100 ng each).

7.1.4 A 20-μL aliquot of the PEG-400 extract or dilution of the waste was injected into the water.

7.1.5 The sample was purged with inert gas at a flow rate of 40 ± 4 mL/min for 8 up to 12 min ± 0.1 min at ambient temperature.

7.1.6 At the end of the purge period, the valves were switched to the desorb mode so that the trapped organics were desorbed at 180°C with a flow rate of 30 mL/min.

7.1.7 The GC/MS analysis employed the following conditions:

Detector: Mass spectrometer scanning over the range of 40 to 260 amu
Column: 2.8 m x 2 mm ID, glass tube packed with 1% SP-1000 on 60/80 mesh Carbopack B (or equivalent)
Suggested column temperature program: 45°C (hold 3 min) to 220°C (15-min hold) at 8°C/min (higher upper temperature may be possible consistent with packing temperature limits of alternative columns)

7.1.8 After 3 min, the valves were switched from desorb mode to purge mode.

7.1.9 The purging chamber was replaced with clean purging chamber.

7.1.10 Desorption and heating of the trap was continued to 200°C in preparation for next run.

7.1.11 The GC/MS data were screened for target POHCs and internal standards using the computer-automated reverse search routine.

7.1.12 The quantification report was inspected from the reverse search to ensure that internal and method internal (surrogate) standards were found and that the area counts are within ± 35% of the value from the calibration standard.

If several of the sample compounds were outside the established curve during the GC/MS analysis, the sample was reanalyzed using an appropriately diluted aliquot of the PEG-400 extract.

7.2 GC/MS ANALYSIS OF AQUEOUS SAMPLES FOR VOLATILES

Aqueous samples are analyzed for volatile compounds by a purge-and-trap method using GC/MS (essentially EPA Method 624) according to the procedures described below. Complete details are given in Method 624, Federal Register, October 26, 1984 (49 FR 43234).

7.2.1 The mass spectrometer was calibrated to ensure that EPA-specified tuning criteria are met for BFB and that m/z 84 for 100 ng of D_6-benzene yields about 100,000 area counts ± 50% for analysis of a reagent water method blank.

7.2.2 A 5.0-mL aliquot of the water sample from a full 40-mL VOA vial was added to the purging device.

7.2.3 The water was spiked with the surrogate standards and internal standard (100 ng each).

7.2.4 The sample was purged with an inert gas at a flow rate of 40 ± 4 mL/min for 8 up to 12 min ± 0.1 min ambient temperature.

7.2.5 At the end of the purge period, the valves switched to the desorb mode so that the trapped organics are desorbed at 180°C with a flow rate of 30 mL/min.

7.2.6 The GC/MS analysis conditions and procedure utilized for aqueous samples was identical to that described in 7.1.7 to 7.1.12 for waste feed analysis.

7.3 ANALYSIS OF TENAX AND TENAX/CHARCOAL ADSORBENT TRAPS (VOST TRAPS) FOR VOLATILES

7.3.1 Sample Spiking by Flash Vaporization

Internal standard compounds are introduced into each VOST trap prior to desorption for analysis. A special spiking accessory was used for this step. The accessory consists of a trap holder, a heated GC-type septum injector, and a supply of helium gas with regulator. During spiking, the VOST trap is downstream from the injector port.

A standard solution containing 50 ng/μL of each internal standard in methanol was required. In addition, methanolic calibration standards containing 50 ng/μL of the internal standards were required along with the appropriate concentrations of target analytes. Two (2) μL of one of these solutions was used for spiking traps as follows.

7.3.1.1 Spiking blanks and samples - The helium flow to the spiking accessory was turned off. Caps from a blank or sample VOST trap were removed and inserted into the spiking accessory. The trap was sealed in the spiking accessory with the knurled nut.

7.3.1.2 Helium gas was turned on. Using the solvent-flush technique, 2 μL of the internal standard solution was injected into the vaporizing port of the spiking accessory.

7.3.1.3 After 15 sec, the gas flow was shut off and the syringe needle withdrawn.

7.3.1.4 The VOST trap was removed from the spiking accessory and either transferred immediately to the desorption oven (below) for analysis or the caps were replaced and it was stored in clean conditions until analyzed. All spiked VOST traps were analyzed within 24 hr. The area counts of the internal standard must agree ± 35% of the values for the calibration standard.

7.3.1.5 Spiking traps to be analyzed as standards - Turn off the helium flow to the spiking accessory. Caps were removed from a blank VOST trap and the trap sealed into the spiking accessory. Helium flow was restored. A 2-μL aliquot of the appropriate methanolic standard containing target analytes and internal standards was injected following the procedure in 7.3.1.2 and 7.3.1.3.

7.3.1.6 The standard-spiked VOST trap was removed from the spiking accessory and transferred to the desorption oven for analysis.

7.3.2 GC/MS Analysis of Adsorbent Traps VOST Traps

7.3.2.1 The purge-trap-desorb and GC/MS system for analysis of trap was prepared according to the following procedure:

- Turn six-port valve to "purge" mode
- Cool purge-trap-desorb analytical trap to ambient temperature
- Ensure flow rate of helium through desorption unit and purge tower is 40 mL/min (N_2 or He can be used)

7.3.2.2 The adsorbent trap was inserted into the desorption unit. After verifying that the purge flow is 40 mL/min, the adsorbent trap heater was turned to 180°C.

7.3.2.3 The data acquisition information was entered in the GC/MS data system.

7.3.2.4 At the end of 10.0 min, the following procedure was executed:

- Switch to the desorb mode so that the trapped organics are desorbed at 180°C with a flow rate of 30 mL/min.
- Start the GC program.
- Start the GC/MS data acquisition. (The data acquisition should continue for sufficient time for analysis completion. The GC oven should also be set to cool to 40°C at the end of the acquisition.)
- After 3 min, switch the six-port valve back to "purge" mode.

8.0 GC/MS ANALYSIS OF MM5 SAMPLE TRAIN COMPONENTS FOR SEMIVOLATILE ORGANIC COMPOUNDS

1. Methylene chloride extracts from combined MM5 trains and laboratory blanks were spiked with recovery internal standard solution prior to submission for GC/MS analysis.

2. The mass spectrometer was calibrated daily with perfluorotributylamine (FC-43) using calibration procedures specified by the manufacturer.

3. Operating conditions for the GC/MS analysis are summarized in Table A-2.

4. Spectra, enhanced spectra, NBS mass spectral, and library searches were obtained for each peak with an area of greater than 20,000 counts using a computer-automated routine.

TABLE A-2. OPERATING PARAMETERS FOR GC/MS ANALYSIS OF SEMIVOLATILE ORGANIC COMPOUNDS

Parameter	Operating parameter
Mass spectrometer	Finnigan MAT 4000
Gas chromatograph	Finnigan MAT 9610
Data system	INCOS data system
Column	30 m x 0.25 mm ID
Liquid phase	DB-5
Liquid phase thickness	0.25 µm
Carrier gas	Helium
Carrier gas velocity	20-45 cm/sec
Injector	"Grob" (splitless mode)
Injector temperature	170°C
Injection volume	1.0 µL
Initial column temperature	40°C (4-min hold)
Column temperature program	40°-300°C at 10°C/min
Separator and transfer line temperature	300°C
Electron energy	70 eV
Scan range	35-450 amu
Scan time	1 sec

9.0 ALDEHYDE ANALYSIS

Samples were filtered into a 14-mL amber vial using 0.45 μm Acrodisc® syringe-type filters. Between samples the syringe was rinsed with acetonitrile (B&J Lot No. AM912) three times and rinsed with 3 to 5 mL of sample to be filtered. Ten milliliters of sample was then filtered into the vial.

The HPLC system was set up with the following parameters:

Pump: Water's 6000A
Detector: Water's Model 440
Injector: Rheodyne, 10 μL loop size
Recorder: Heath, chart speed: 0.2 in/min
Mobile phase: 60% Acetonitrile/40% H_2O, isocratic
Column: Partisil 5 ODS3, particle size: 5 μm, length: 25 cm, ID: 4.6 mm, type: C_{18}
Flow rate: 1 mL/min
Wavelength: 254 nm, AUFS = 0.05
Back pressure: 1,500 psi

10.0 METALS

1. The liquid organic waste composites, solid cellulose composites, solid polyethylene wax composites, and solid pyridine composites were prepared by the acid digestion procedure described in Method 3050 of the EPA SW-846 Manual, Third Edition. The aqueous waste composites were prepared by the acid digestion procedure described in Method 3005 of the same manual.

2. Standards were prepared at appropriate concentrations from Standard Analytical Reference Materials manufactured by Inorganic Ventures, Inc. These standards were prepared by volume in a 10% (v/v) nitric acid matrix in units of micrograms per milliliter. The upper instrumental calibration limit for all analytes was 50 µg/mL except for Be and Ba which was 10 µg/mL.

3. The samples were analyzed on a Perkin-Elmer Plasma II ICP-AES which calibrated using the manufacturer's recommended technique. All samples were analyzed by the procedure described in Method 6010 of the EPA SW-846 Manual, Third Edition.

Various quality control measures were used. Calibration blanks and instrument check standards were analyzed at a frequency of 10%. Percent instrument drift calculated from these instrument check standard determinations was found to be less than 10% for all analytes. An interference check standard was analyzed at the beginning and end of the analytical run to verify the spectral background corrections used. All analyte concentrations (µg/mL) were within 20% of the expected concentrations (µg/mL). Accuracy Quality Control (AQC) standards were also prepared at a 1.00-µg/mL level from standards manufactured by Spex Industries, Inc. The AQC standard concentrations found were within 10% of the expected concentrations for all analytes with the exception of Cu and Tl which were +13.1 and +12.7% from the expected concentrations, respectively.

11.0 CHLORIDE ANALYSIS

The chloride samples were analyzed using ion chromatography, according to ASTM Method D4327. The concentrations of the samples were calculated from a three-point calibration curve, plotting concentration versus peak area. The average peak areas from the calibration standards and the known concentrations of the standards were entered into a least-squares curve fit program and the sample concentrations were plotted along this line. All samples and standards were analyzed in duplicate, and the average peak areas were used in calculations.

I.C. Specifications:
Instrument: Dionex 4000i
Column/guard: AS4A/AG5
Eluant: 3.0 mM Sodium bicarbonate/2.4 mM sodium carbonate
Eluant flow rate: 2.0 mL/min
Regenerate: 25 mM Sulfuric acid
Attenuation: 30 μ-sec
Chart speed: 0.5 in/min

APPENDIX B

DATA

This appendix consists of raw data, intermediate calculations and final results for the various constituents of interest in the report. In particular, the following sections have been established:

- Volatile Organic Stack Data
- Semivolatile Organic Stack Data
- Aldehyde Data
- Field Gas Chromatography Data
- Waste Analysis Data
- Metals Analysis Data
- Scrubber Water Analysis Data
- Chloride Data
- Particulate and Stack Data

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VOLATILE ORGANIC STACK DATA

The data for the VOST analysis by trap are shown in Table B-1. These data are in terms of total ng/trap. Results of the VOST audit analysis are also presented.

Calculation of volatile constituent concentrations involved several steps.

1. Values for each trap (ng) were combined into a total for each pair.
2. Concentrations (ng/L) for each pair were determined from the nanogram total and division by sample gas volume (corrected to STP).
3. Average concentration for the run was determined. Table B-2 shows this step.
4. Emissions (ppb) were calculated through division by a factor based on the compound's molecular weight, as shown in Table B-3.
5. Emissions (ppb methane) were calculated through multiplication of ppb emissions by a factor based on the compound's carbon number, as shown in Table B-4.

TABLE B-1. VOST TRAP DATA

(ng in trap)

Compound	RUN 1 PAIR 1 TENAX	TNX/CHA	TOTAL	GAS VOL. STD (L)	PAIR 2 TENAX	TNX/CHA	TOTAL	GAS VOL. STD (L)	PAIR 3 TENAX	TNX/CHA	TOTAL	GAS VOL STD (L)
Methyl chloride	154.1	24.3	178.4	19.1		2096.6		18.8	4.6			20.2
Methyl bromide	1.0	2.1	3.1			0.0			0.0			
Vinyl chloride	0.0	42.9	42.9			38.6			27.6			
Chloroethane	0.0	0.0	0.0			9.0			0.0			
Dichloromethane	158.0	84.5	157.5			17.1			0.0			
Trichlorofluoromethane	50.3	408.5	445.3			181.6			14.4			
1,1 dichloroethylene	30.7	46.6	77.3			68.3			7.1			
1,1 dichloroethane	0.2	0.0	0.2			0.0			0.0			
trans-1,2-dichloroethylene	0.4	0.0	0.4			0.0			0.0			
Chloroform	5274.7	673.2	5947.9			533.4			5626.1			
1,2 dichloroethane	197.3	3.4	200.8			2.8			79.9			
1,1,1 trichloroethane	15.5	10.5	26.0			5.6			23.1			
Carbon tetrachloride	334.5	134.8	469.3			137.0			145.4			
Dichlorobromomethane	1827.2	0.0	1827.2			0.0			2000.8			
1,2 dichloropropane	111.1	0.0	111.1			0.0			65.6			
cis-1,3-dichloropropene	3.9	0.0	3.9			0.0			5.4			
Trichloroethylene	6.4	0.0	6.4			0.6			3.3			
Benzene	290.5	16.6	279.1			15.7			95.7			
Chlorodibromomethane	378.6	0.0	378.6			2.4			833.8			
1,1,2-trichloroethane	4.8	0.0	4.8			0.0			0.0			
trans-1,3-dichloropropene	0.0	0.0	0.0			0.0			5.9			
2-chloroethyl vinyl ether	0.0	166.4	149.4			0.0			0.0			
Bromoform	28.9	0.0	28.9			2.3			855.2			
1,1,2,2-tetrachloroethane	7.1	0.0	7.1			4.2			3.0			
1,1,2,2-Tetrachloroethylene	157.1	1.9	159.1			114.4			80.5			
Toluene	573.3	4.3	577.6			325.9			172.3			
Chlorobenzene	10.4	0.0	10.4			13.9			8.3			
Ethylbenzene	84.5	2.2	86.6			84.7			16.9			

TABLE B-1 (Continued)

	RUN 1			GAS VOL.				GAS VOL.				GAS VOL
	PAIR 1			STD	PAIR 2			STD	PAIR 3			STD
Compound	TENAX	TNX/CHA	TOTAL	(L)	TENAX	TNX/CHA	TOTAL	(L)	TENAX	TNX/CHA	TOTAL	(L)
Gas volume				19.1				18.8				20.2
C3H4	0.0	0.0	0.0			0.0			0.0			
Acetaldehyde	0.0	0.0	0.0			0.0			0.0			
Dimethyl Ether	650.2	51.8	683.8			33.4			0.0	171.9	153.7	
Dichlorodifluoromethane	0.0	13.1	13.1			0.0			0.0			
Acetonitrile	0.0	0.0	0.0			0.0			15.8			
Polyfluoroalkane	0.0	86.8	86.8			103.9			0.0	218.3	218.3	
C4H10	0.0	0.0	0.0			18.7			0.0			
Dichlorotetrafluoroethane(a)	0.0	0.0	0.0			0.0			0.0			
C4H8/Acetone	145.2	256.9	188.0			81.7			90.7	202.4	79.0	
CHO Compound	0.0	0.0	0.0			0.0			0.0			
Carbon Disulfide	14.1	0.0	14.1			0.0			0.0			
Chloropropene	0.0	0.0	0.0			0.0			10.3			
CHO Compound	0.0	0.0	0.0			0.0			0.0			
Bromochloromethane	0.0	0.0	0.0			0.0			0.0			
Tetrahydrofuran/C5H12	22.6	0.0	22.6			14.0			0.0			
C5H8/C5H10	0.0	0.0	0.0			0.0			0.0			
C5H6	0.0	0.0	0.0			0.0			0.0			
Trichlorotrifluoroethane(a)	0.0	0.0	0.0			0.0			0.0			
C5H12/C6H12	24.7	29.6	54.3			0.0			15.5	128.5	144.0	
1,4-Dioxane(a)	0.0	0.0	0.0			0.0			0.0			
C6H12/C6H14	0.0	123.3	123.3			6.0			0.0	218.2	218.2	
C5H12O2	0.0	0.0	0.0			0.0			0.0			
C6H12	0.0	14.1	14.1			0.0			0.0	32.1	32.1	
Dichloroacetonitrile	277.1	0.0	277.1			0.0			122.2			
C7H14/C6H12	0.0	0.0	0.0			53.2			0.0			
hydrocarbon	0.0	0.0	0.0			0.0			105.8			
C7H14/C7H16	17.7	9.9	27.6			25.6			19.3	45.1	64.3	
CHO Compound	0.0	0.0	0.0			0.0			0.0			
C7H14/C7H16	361.9	198.3	560.2			134.8			0.0	115.6	115.6	
C6H12	0.0	0.0	0.0			0.0			0.0			
C7H14/C7H16	52.3	31.3	83.6			0.0			15.7			
hydrocarbon	0.0	9.7	9.7			0.0			0.0			
C7H12	0.0	0.0	0.0			0.0			0.0			
C7H16	119.3	31.3	150.6			13.1			44.8	213.3	258.1	
hydrocarbon/Polyfluoroalkane	0.0	0.0	0.0			0.0			0.0			
Polyfluoroalkane	0.0	0.0	0.0			0.0			0.0	87.7	87.7	
Isooctane	0.0	111.2	111.2			0.0			26.5			
hydrocarbon	53.8	51.0	104.8			0.0			0.0			
hydrocarbon	148.8	0.0	148.8			0.0			52.2			

TABLE B-1 (Continued)

Compound	RUN 2 PAIR 1 TENAX	TNX/CHA	TOTAL	GAS VOL. STD (L)	PAIR 2 TENAX	TNX/CHA	TOTAL	GAS VOL. STD (L)	PAIR 3 TENAX	TNX/CHA	TOTAL	GAS VOL STD (L)
Methyl chloride		2850.8		19.9		426.3		19.0	0.0	0.0	0.0	20.8
Methyl bromide		4.0				0.0			1.4	0.0	1.4	
Vinyl chloride		31.2				0.0			0.0	0.0	0.0	
Chloroethane		21.9				17.0			0.0	0.0	0.0	
Dichloromethane		53.2				0.0			3.5	59.2	0.0	
Trichlorofluoromethane		45.3				9.0			1.0	0.7	0.0	
1,1 dichloroethylene		2.3				3.1			0.0	0.0	0.0	
1,1 dichloroethane		0.0				0.0			0.0	0.0	0.0	
trans-1,2-dichloroethylene		0.0				0.6			0.0	0.0	0.0	
Chloroform		204.7				111.7			16.1	8.6	24.7	
1,2 dichloroethane		1.4				0.0			0.0	1.1	1.1	
1,1,1 trichloroethane		7.8				23.8			9.7	19.3	29.0	
Carbon tetrachloride		22.3				22.8			0.0	5.6	5.6	
Dichlorobromomethane		0.0				0.0			2.4	0.0	2.4	
1,2 dichloropropane		0.0				0.0			0.9	0.0	0.9	
cis-1,3-dichloropropene		0.0				0.0			0.0	0.0	0.0	
Trichloroethylene		1.1				1.0			0.0	0.0	0.0	
Benzene		61.4				12.7			15.3	43.1	30.4	
Chlorodibromomethane		0.0				0.0			0.0	0.0	0.0	
1,1,2-trichloroethane		0.0				0.0			0.0	0.0	0.0	
trans-1,3-dichloropropene		0.0				0.0			0.0	0.0	0.0	
2-chloroethyl vinyl ether		0.0				0.0			31.7	0.0	14.7	
Bromoform		0.0				0.0			0.0	0.0	0.0	
1,1,2,2-tetrachloroethane		0.0				0.0			0.0	0.0	0.0	
1,1,2,2-Tetrachloroethylene		1.7				0.2			1.4	5.1	6.5	
Toluene		27.1				3.4			2.7	9.2	11.9	
Chlorobenzene		0.0				0.0			0.0	0.0	0.0	
Ethylbenzene		1.3				1.6			2.5	0.9	3.4	

TABLE B-1 (Continued)

Compound	RUN 2 PAIR 1 TENAX	TNX/CHA	TOTAL	GAS VOL. STD (L)	PAIR 2 TENAX	TNX/CHA	TOTAL	GAS VOL. STD (L)	PAIR 3 TENAX	TNX/CHA	TOTAL	GAS VOL STD (L)
Gas volume				19.9				19.0				20.8
C3H4		0.0				0.0			0.0	0.0	0.0	
Acetaldehyde		0.0				0.0			0.0	0.0	0.0	
Dimethyl Ether		16.2				3.1			25.9	0.0	7.7	
Dichlorodifluoromethane		0.0				0.0			0.0	0.0	0.0	
Acetonitrile		0.0				0.0			0.0	0.0	0.0	
Polyfluoroalkane		98.4				23.1			0.0	0.0	0.0	
C4H10		0.0				0.0			0.0	0.0	0.0	
Dichlorotetrafluoroethane(a)		0.0				0.0			0.0	0.0	0.0	
C4H8/Acetone		62.8				452.7			344.4	133.1	263.5	
CHO Compound		0.0				0.0			14.4	0.0	14.4	
Carbon Disulfide		0.0				0.0			0.0	0.0	0.0	
Chloropropene		0.0				0.0			0.0	0.0	0.0	
CHO Compound		0.0				0.0			0.0	0.0	0.0	
Bromochloromethane		0.0				0.0			0.0	0.0	0.0	
Tetrahydrofuran/C5H12		0.0				0.0			14.7	0.0	14.7	
C5H8/C5H10		0.0				0.0			0.0	0.0	0.0	
C5H6		0.0				0.0			0.0	0.0	0.0	
Trichlorotrifluoroethane(a)		0.0				0.0			0.0	0.0	0.0	
C5H12/C6H12		80.7				0.0			20.5	0.0	20.5	
1,4-Dioxane(a)		0.0				0.0			0.0	0.0	0.0	
C6H12/C6H14		30.1				10.3			0.0	10.7	10.7	
C5H12O2		0.0				0.0			0.0	0.0	0.0	
C6H12		0.0				0.0			0.0	0.0	0.0	
Dichloroacetonitrile		0.0				0.0			0.0	0.0	0.0	
C7H14/C6H12		0.0				0.0			0.0	0.0	0.0	
hydrocarbon		0.0				0.0			0.0	0.0	0.0	
C7H14/C7H16		0.0				0.0			0.0	0.0	0.0	
CHO Compound		0.0				21.8			22.5	0.0	22.5	
C7H14/C7H16		46.5				0.0			0.0	0.0	0.0	
C6H12		0.0				0.0			0.0	0.0	0.0	
C7H14/C7H16		0.0				0.0			0.0	0.0	0.0	
hydrocarbon		0.0				0.0			20.5	0.0	20.5	
C7H12		0.0				0.0			0.0	0.0	0.0	
C7H16		0.0				0.0			0.0	0.0	0.0	
hydrocarbon/Polyfluoroalkane		12.9				0.0			0.0	0.0	0.0	
Polyfluoroalkane		44.1				0.0			0.0	0.0	0.0	
Isooctane		0.0				22.5			0.0	0.0	0.0	
hydrocarbon		0.0				0.0			0.0	0.0	0.0	
hydrocarbon		0.0				0.0			0.0	0.0	0.0	

TABLE B-1 (Continued)

	RUN 3			GAS VOL.				GAS VOL.				GAS VOL
	PAIR 1			STD	PAIR 2			STD	PAIR 3			STD
Compound	TENAX	TNX/CHA	TOTAL	(L)	TENAX	TNX/CHA	TOTAL	(L)	TENAX	TNX/CHA	TOTAL	(L)
Methyl chloride	0.0	21.2	21.2	20.8	106.2	43.8	150.1	22.0	22.3	37.0	59.3	19.2
Methyl bromide	4.6	12.3	16.9		6.0	0.0	6.0		11.4	0.0	11.4	
Vinyl chloride	0.0	12.4	12.4		13.1	50.0	63.1		0.0	114.0	29.3	
Chloroethane	0.0	1.5	1.5		0.0	0.0	0.0		0.0	0.0	0.0	
Dichloromethane	98.1	79.6	92.6		44.9	30.7	0.0		82.4	31.9	114.3	
Trichlorofluoromethane	8.0	17.3	11.8		7.3	9.1	2.9		6.8	11.4	4.7	
1,1 dichloroethylene	3.7	1.1	4.8		3.9	0.5	4.4		3.0	0.0	3.0	
1,1 dichloroethane	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
trans-1,2-dichloroethylene	0.0	0.0	0.0		0.2	0.0	0.2		0.0	0.0	0.0	
Chloroform	7371.2	57.8	7429.0		6163.5	3.2	6166.7		6234.6	17.4	6252.1	
1,2 dichloroethane	14.4	1.8	16.2		10.7	0.1	10.8		11.4	13.4	24.8	
1,1,1 trichloroethane	125.1	38.6	163.7		97.3	14.8	112.1		109.1	11.9	121.0	
Carbon tetrachloride	141.1	28.2	169.4		165.9	12.8	178.6		145.7	3.8	149.5	
Dichlorobromomethane	2089.0	4.4	2093.4		1724.4	1.0	1725.4		1811.0	0.0	1811.0	
1,2 dichloropropane	0.0	0.0	0.0		2.6	0.0	2.6		0.0	0.0	0.0	
cis-1,3-dichloropropene	1.5	0.0	1.5		3.1	0.0	3.1		1.3	0.0	1.3	
Trichloroethylene	3.7	0.3	4.0		3.8	0.7	4.5		2.6	18.4	21.0	
Benzene	177.4	39.7	189.0		98.7	25.5	96.2		80.4	0.0	52.4	
Chlorodibromomethane	342.8	0.2	343.0		297.1	0.0	297.1		283.9	0.0	283.9	
1,1,2-trichloroethane	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
trans-1,3-dichloropropene	3.1	0.0	3.1		4.1	0.0	4.1		1.1	0.0	1.1	
2-chloroethyl vinyl ether	0.0	0.0	0.0		75.6	0.0	58.6		0.0	0.0	0.0	
Bromoform	6.0	0.0	6.0		5.7	0.0	5.7		4.1	0.0	4.1	
1,1,2,2-tetrachloroethane	4.6	0.0	4.6		2.1	2.1	4.2		3.9	0.0	3.9	
1,1,2,2-Tetrachloroethylene	74.8	2.5	77.3		51.4	0.0	51.4		44.5	0.0	44.5	
Toluene	85.2	8.0	93.1		60.7	3.9	64.6		60.3	1.9	62.2	
Chlorobenzene	7.0	0.0	7.0		5.6	0.0	5.6		9.3	0.0	9.3	
Ethylbenzene	12.6	0.5	13.1		10.2	0.0	10.2		11.2	1.4	12.5	

TABLE B-1 (Continued)

	RUN 3			GAS VOL.				GAS VOL.				GAS VOL
	PAIR 1			STD	PAIR 2			STD	PAIR 3			STD
Compound	TENAX	TNX/CHA	TOTAL	(L)	TENAX	TNX/CHA	TOTAL	(L)	TENAX	TNX/CHA	TOTAL	(L)
Gas volume				20.8				22.0				19.2
C3H4	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
Acetaldehyde	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
Dimethyl Ether	0.0	38.4	20.2		26.9	13.5	22.1		0.0	0.0	0.0	
Dichlorodifluoromethane	0.0	0.0	0.0		0.0	9.7	9.7		0.0	36.0	36.0	
Acetonitrile	0.0	0.0	0.0		0.0	0.0	0.0		13.9	0.0	13.9	
Polyfluoroalkane	0.0	20.3	20.3		0.0	11.4	11.4		0.0	18.0	18.0	
C4H10	0.0	0.0	0.0		0.0	10.6	10.6		0.0	17.8	17.8	
Dichlorotetrafluoroethane(a)	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
C4H8/Acetone	193.9	249.0	228.9		231.4	101.1	118.5		190.7	175.6	152.3	
CHO Compound	0.0	0.0	0.0		0.0	0.0	0.0		0.0	11.9	11.9	
Carbon Disulfide	0.0	0.0	0.0		12.7	0.0	12.7		16.5	0.0	16.5	
Chloropropene	14.3	0.0	14.3		14.3	0.0	14.3		13.5	0.0	13.5	
CHO Compound	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
Bromochloromethane	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
Tetrahydrofuran/C5H12	0.0	0.0	0.0		13.8	0.0	13.8		0.0	0.0	0.0	
C5H8/C5H10	0.0	0.0	0.0		0.0	0.0	0.0		34.0	0.0	34.0	
C5H6	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
Trichlorotrifluoroethane(a)	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
C5H12/C6H12	0.0	0.0	0.0		0.0	0.0	0.0		48.6	0.0	48.6	
1,4-Dioxane(a)	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
C6H12/C6H14	0.0	16.2	16.2		0.0	7.8	7.8		0.0	0.0	0.0	
C5H12O2	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
C6H12	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
Dichloroacetonitrile	55.9	28.4	84.3		51.1	0.0	51.1		35.2	14.5	49.7	
C7H14/C6H12	0.0	0.0	0.0		0.0	0.0	0.0		23.2	0.0	23.2	
hydrocarbon	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
C7H14/C7H16	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
CHO Compound	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
C7H14/C7H16	29.1	15.7	44.7		21.1	0.0	21.1		29.5	0.0	29.5	
C6H12	0.0	0.0	0.0		0.0	0.0	0.0		0.0	17.0	17.0	
C7H14/C7H16	13.6	0.0	13.6		13.0	0.0	13.0		0.0	0.0	0.0	
hydrocarbon	0.0	0.0	0.0		0.0	0.0	0.0		26.2	0.0	26.2	
C7H12	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
C7H16	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
hydrocarbon/Polyfluoroalkane	0.0	0.0	0.0		0.0	0.0	0.0		39.5	0.0	39.5	
Polyfluoroalkane	0.0	37.4	37.4		0.0	0.0	0.0		0.0	13.2	13.2	
Isooctane	86.5	0.0	86.5		69.2	0.0	69.2		69.2	0.0	69.2	
hydrocarbon	0.0	0.0	0.0		0.0	0.0	0.0		33.3	0.0	33.3	
hydrocarbon	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	

TABLE B-1 (Continued)

Compound	RUN 4 PAIR 1 TENAX	TNX/CHA	TOTAL	GAS VOL. STD (L)	PAIR 2 TENAX	TNX/CHA	TOTAL	GAS VOL. STD (L)	PAIR 3 TENAX	TNX/CHA	TOTAL	GAS VOL STD (L)
Methyl chloride	26.4			11.8	7.8	142.1	149.9	11.0	6.1	76.5	82.6	11.0
Methyl bromide	97.0				8.5	100.7	109.2		5.0	88.8	93.9	
Vinyl chloride	0.0				0.0	22.4	22.4		0.0	18.6	18.6	
Chloroethane	0.0				0.0	0.0	0.0		1.0	0.0	1.0	
Dichloromethane	46.9				76.9	118.0	109.9		221.2	1.0	137.1	
Trichlorofluoromethane	5.9				8.5	8.2	3.2		11.3	5.9	3.7	
1,1 dichloroethylene	9.5				4.5	0.0	4.5		6.6	0.0	6.6	
1,1 dichloroethane	0.0				0.0	0.0	0.0		0.0	0.0	0.0	
trans-1,2-dichloroethylene	0.2				0.0	0.0	0.0		0.7	0.0	0.7	
Chloroform	4385.2				3475.1	18.3	3493.4		4439.4	16.0	4455.4	
1,2 dichloroethane	20.5				26.0	0.9	26.9		22.7	0.0	22.7	
1,1,1 trichloroethane	60.4				24.9	2.0	26.9		60.0	3.6	63.6	
Carbon tetrachloride	408.5				378.8	15.6	394.5		617.2	16.1	633.3	
Dichlorobromomethane	1371.7				1089.0	2.7	1091.8		1328.1	2.2	1330.3	
1,2 dichloropropane	4.2				0.0	0.0	0.0		3.8	0.0	3.8	
cis-1,3-dichloropropene	1.4				0.7	0.0	0.7		0.0	0.0	0.0	
Trichloroethylene	4.5				2.9	0.0	2.9		6.4	0.4	6.8	
Benzene	3799.2				377.3	45.8	395.0		3953.9	10.9	3936.8	
Chlorodibromomethane	409.4				530.8	1.1	531.9		361.0	0.3	361.2	
1,1,2-trichloroethane	1.1				0.0	0.0	0.0		1.6	0.0	1.6	
trans-1,3-dichloropropene	2.9				0.6	0.0	0.6		0.0	0.0	0.0	
2-chloroethyl vinyl ether	118.4				27.6	0.0	10.6		104.5	0.0	87.5	
Bromoform	827.6				983.8	5.5	989.3		481.2	1.9	483.1	
1,1,2,2-tetrachloroethane	3.7				0.0	0.0	0.0		1.2	0.0	1.2	
1,1,2,2-Tetrachloroethylene	33.6				13.0	0.0	13.0		25.7	0.0	25.7	
Toluene	72.2				32.5	24.9	57.4		82.0	1.1	83.2	
Chlorobenzene	35.5				22.8	0.0	22.8		35.3	0.0	35.3	
Ethylbenzene	6.7				67.3	0.6	67.9		8.7	0.0	8.7	

TABLE B-1 (Continued)

	RUN 4			GAS VOL.				GAS VOL.				GAS VOL
	PAIR 1			STD	PAIR 2			STD	PAIR 3			STD
Compound	TENAX	TNX/CHA	TOTAL	(L)	TENAX	TNX/CHA	TOTAL	(L)	TENAX	TNX/CHA	TOTAL	(L)
Gas volume				11.8				11.0				11.0
C_3H_4	0.0				0.0	0.0	0.0		0.0	20.9	20.9	
Acetaldehyde	0.0				0.0	0.0	0.0		0.0	0.0	0.0	
Dimethyl Ether	0.0				0.0	0.0	0.0		0.0	59.1	40.9	
Dichlorodifluoromethane	0.0				0.0	9.7	9.7		0.0	0.0	0.0	
Acetonitrile	8.3				0.0	0.0	0.0		15.6	0.0	15.6	
Polyfluoroalkane	0.0				0.0	0.0	0.0		0.0	0.0	0.0	
C_4H_{10}	0.0				0.0	23.5	23.5		0.0	20.6	20.6	
Dichlorotetrafluoroethane(a)	0.0				0.0	0.0	0.0		0.0	0.0	0.0	
C_4H_8/Acetone	156.7				166.6	209.2	161.8		228.9	92.6	214.4	
CHO Compound	0.0				0.0	0.0	0.0		0.0	0.0	0.0	
Carbon Disulfide	24.6				11.8	0.0	11.8		25.5	0.0	25.5	
Chloropropene	0.0				10.7	0.0	10.7		12.8	0.0	12.8	
CHO Compound	0.0				0.0	0.0	0.0		0.0	0.0	0.0	
Bromochloromethane	0.0				0.0	0.0	0.0		0.0	0.0	0.0	
Tetrahydrofuran/C_5H_{12}	16.9				14.5	0.0	14.5		18.4	0.0	18.4	
C_5H_8/C_5H_{10}	0.0				0.0	0.0	0.0		0.0	0.0	0.0	
C_5H_6	0.0				0.0	0.0	0.0		0.0	0.0	0.0	
Trichlorotrifluoroethane(a)	0.0				0.0	0.0	0.0		0.0	0.0	0.0	
C_5H_{12}/C_6H_{12}	0.0				0.0	0.0	0.0		0.0	0.0	0.0	
1,4-Dioxane(a)	0.0				0.0	0.0	0.0		0.0	0.0	0.0	
C_6H_{12}/C_6H_{14}	0.0				0.0	30.5	30.5		0.0	9.4	9.4	
$C_5H_{12}O_2$	0.0				0.0	0.0	0.0		0.0	0.0	0.0	
C_6H_{12}	0.0				0.0	0.0	0.0		0.0	0.0	0.0	
Dichloroacetonitrile	36.5				24.2	0.0	24.2		38.1	0.0	38.1	
C_7H_{14}/C_6H_{12}	0.0				0.0	0.0	0.0		0.0	0.0	0.0	
hydrocarbon	0.0				47.0	0.0	47.0		81.4	0.0	81.4	
C_7H_{14}/C_7H_{16}	0.0				0.0	0.0	0.0		0.0	0.0	0.0	
CHO Compound	0.0				0.0	0.0	0.0		0.0	0.0	0.0	
C_7H_{14}/C_7H_{16}	0.0				0.0	0.0	0.0		0.0	0.0	0.0	
C_6H_{12}	0.0				0.0	0.0	0.0		0.0	0.0	0.0	
C_7H_{14}/C_7H_{16}	51.4				45.1	0.0	45.1		85.7	0.0	85.7	
hydrocarbon	0.0				8.3	0.0	8.3		0.0	0.0	0.0	
C_7H_{12}	0.0				0.0	0.0	0.0		30.9	0.0	30.9	
C_7H_{16}	12.8				0.0	0.0	0.0		0.0	0.0	0.0	
hydrocarbon/Polyfluoroalkane	0.0				0.0	0.0	0.0		11.0	0.0	11.0	
Polyfluoroalkane	0.0				0.0	28.2	28.2		0.0	0.0	0.0	
Isooctane	1754.8				1799.3	0.0	1799.3		2737.5	8.2	2745.7	
hydrocarbon	0.0				113.5	0.0	113.5		0.0	0.0	0.0	
hydrocarbon	0.0				0.0	0.0	0.0		0.0	0.0	0.0	

TABLE B-1 (Continued)

	RUN 5			GAS VOL.				GAS VOL.				GAS VOL
	PAIR 1			STD	PAIR 2			STD	PAIR 3			STD
Compound	TENAX	TNX/CHA	TOTAL	(L)	TENAX	TNX/CHA	TOTAL	(L)	TENAX	TNX/CHA	TOTAL	(L)
Methyl chloride	141.8	1230.1	1371.9	11.1	121.5	1402.2	1523.7	11.0	233.5	131.5	365.0	10.9
Methyl bromide	63.5	10.0	73.5		182.4	25.3	207.7		90.9	119.3	210.1	
Vinyl chloride	0.0	31.3	31.3		0.0	46.1	46.1		20.6	54.4	75.0	
Chloroethane	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
Dichloromethane	3131.8	17.0	3063.7		6653.7	108.7	6627.4		7092.3	412.3	7419.5	
Trichlorofluoromethane	13.9	9.5	9.9		10.7	7.1	4.2		11.3	21.3	19.2	
1,1 dichloroethylene	5.2	0.0	5.2		7.9	0.0	7.9		23.0	0.0	23.0	
1,1 dichloroethane	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
trans-1,2-dichloroethylene	0.0	0.0	0.0		3.4	0.0	3.4		5.4	0.0	5.4	
Chloroform	1258.1	2.6	1260.7		1637.2	26.0	1663.2		1042.4	8.6	1051.0	
1,2 dichloroethane	3.6	0.0	3.6		3.0	0.0	3.0		4.9	3.0	7.8	
1,1,1 trichloroethane	21.6	0.0	21.6		22.9	1.7	24.6		25.1	1.4	26.6	
Carbon tetrachloride	1097.2	72.2	1169.4		847.7	46.5	894.2		355.7	10.3	366.0	
Dichlorobromomethane	92.2	0.0	92.2		121.8	0.0	121.8		53.2	0.0	53.2	
1,2 dichloropropane	2.5	0.0	2.5		0.0	0.0	0.0		0.0	0.0	0.0	
cis-1,3-dichloropropene	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
Trichloroethylene	3.8	0.1	4.0		4.9	3.0	7.9		3.5	0.0	3.5	
Benzene	832.7	3.4	808.0		1041.7	9.2	1022.9		81.4	113.9	167.3	
Chlorodibromomethane	41.3	0.0	41.3		86.1	0.0	86.1		26.8	0.0	26.8	
1,1,2-trichloroethane	0.0	0.0	0.0		1.2	0.5	1.7		1.9	0.0	1.9	
trans-1,3-dichloropropene	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
2-chloroethyl vinyl ether	50.4	0.0	33.4		105.6	0.0	88.6		102.4	65.7	151.1	
Bromoform	39.1	0.0	39.1		146.6	1.4	148.0		34.8	0.0	34.8	
1,1,2,2-tetrachloroethane	0.0	0.0	0.0		0.0	4.6	4.6		0.9	0.0	0.9	
1,1,2,2-Tetrachloroethylene	12.0	0.0	12.0		10.6	0.0	10.6		11.4	1.5	12.8	
Toluene	37.4	0.0	37.4		36.8	1.8	38.6		20.1	19.1	39.2	
Chlorobenzene	30.0	0.0	30.0		34.9	3.4	38.3		20.7	0.0	20.7	
Ethylbenzene	6.4	1.0	7.4		6.2	9.1	15.2		3.8	0.9	4.7	

TABLE B-1 (Continued)

	RUN 5			GAS VOL.				GAS VOL.				GAS VOL
	PAIR 1			STD	PAIR 2			STD	PAIR 3			STD
Compound	TENAX	TNX/CHA	TOTAL	(L)	TENAX	TNX/CHA	TOTAL	(L)	TENAX	TNX/CHA	TOTAL	(L)
Gas volume				11.1				11.0				10.9
C_3H_4	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
Acetaldehyde	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
Dimethyl Ether	25.4	28.2	35.3		0.0	40.9	22.7		0.0	0.0	0.0	
Dichlorodifluoromethane	0.0	0.0	0.0		0.0	0.0	0.0		0.0	20.1	20.1	
Acetonitrile	0.0	10.8	10.8		16.0	0.0	16.0		0.0	0.0	0.0	
Polyfluoroalkane	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
C_4H_{10}	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
Dichlorotetrafluoroethane(a)	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
C_4H_8/Acetone	285.5	152.9	224.5		125.7	26.9	0.0		156.3	190.5	132.7	
CHO Compound	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
Carbon Disulfide	8.1	0.0	8.1		0.0	0.0	0.0		8.9	0.0	8.9	
Chloropropene	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
CHO Compound	0.0	0.0	0.0		0.0	17.7	17.7		0.0	0.0	0.0	
Bromochloromethane	42.8	0.0	42.8		89.6	0.0	89.6		74.7	0.0	74.7	
Tetrahydrofuran/C_5H_{12}	0.0	0.0	0.0		10.5	0.0	10.5		12.8	0.0	12.8	
C_5H_8/C_5H_{10}	31.1	0.0	31.1		0.0	0.0	0.0		0.0	0.0	0.0	
C_5H_6	11.9	0.0	11.9		0.0	0.0	0.0		0.0	0.0	0.0	
Trichlorotrifluoroethane(a)	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
C_5H_{12}/C_6H_{12}	11.9	0.0	11.9		0.0	0.0	0.0		0.0	0.0	0.0	
1,4-Dioxane(a)	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
C_6H_{12}/C_6H_{14}	0.0	0.0	0.0		49.6	0.0	49.6		0.0	78.4	78.4	
$C_5H_{12}O_2$	0.0	9.7	9.7		0.0	13.4	13.4		0.0	0.0	0.0	
C_6H_{12}	0.0	0.0	0.0		0.0	0.0	0.0		12.2	0.0	12.2	
Dichloroacetonitrile	25.6	0.0	25.6		22.8	0.0	22.8		0.0	0.0	0.0	
C_7H_{14}/C_6H_{12}	28.7	0.0	28.7		0.0	0.0	0.0		0.0	0.0	0.0	
hydrocarbon	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
C_7H_{14}/C_7H_{16}	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
CHO Compound	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
C_7H_{14}/C_7H_{16}	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
C_6H_{12}	0.0	0.0	0.0		0.0	0.0	0.0		0.0	11.9	11.9	
C_7H_{14}/C_7H_{16}	17.5	0.0	17.5		14.0	0.0	14.0		0.0	0.0	0.0	
hydrocarbon	12.7	0.0	12.7		0.0	0.0	0.0		0.0	0.0	0.0	
C_7H_{12}	21.8	0.0	21.8		11.8	0.0	11.8		14.0	0.0	14.0	
C_7H_{16}	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
hydrocarbon/Polyfluoroalkane	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
Polyfluoroalkane	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
Isooctane	246.7	0.0	246.7		183.6	0.0	183.6		139.3	0.0	139.3	
hydrocarbon	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
hydrocarbon	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	

TABLE B-1 (Continued)

	RUN 6			GAS VOL.				GAS VOL.				GAS VOL
	PAIR 1			STD	PAIR 2			STD	PAIR 3			STD
Compound	TENAX	TNX/CHA	TOTAL	(L)	TENAX	TNX/CHA	TOTAL	(L)	TENAX	TNX/CHA	TOTAL	(L)
Methyl chloride	75.4	2755.7	2831.0	11.3		2698.4		11.1	137.5	2344.2	2481.6	12.2
Methyl bromide	255.3	47.1	302.5			11.5			57.2	18.9	76.1	
Vinyl chloride	0.0	99.8	99.8			56.9			0.0	69.9	69.9	
Chloroethane	0.0	0.0	0.0			0.0			0.0	0.0	0.0	
Dichloromethane	3745.1	206.0	3866.1			47.6			3276.6	226.0	3417.6	
Trichlorofluoromethane	15.8	18.6	21.0			28.8			23.8	44.5	54.8	
1,1 dichloroethylene	7.8	0.0	7.8			0.0			15.2	0.9	16.1	
1,1 dichloroethane	0.0	0.0	0.0			0.0			0.3	0.0	0.3	
trans-1,2-dichloroethylene	4.0	0.0	4.0			0.0			3.3	0.0	3.3	
Chloroform	785.4	0.6	786.0			3.5			1283.4	1.1	1284.5	
1,2 dichloroethane	10.7	0.0	10.7			0.0			35.5	0.0	35.5	
1,1,1 trichloroethane	7.1	0.6	7.7			0.2			19.8	2.2	22.0	
Carbon tetrachloride	263.6	50.9	314.5			10.5			170.9	11.9	182.7	
Dichlorobromomethane	183.5	0.0	183.5			0.0			295.7	0.0	295.7	
1,2 dichloropropane	178.4	0.0	178.4			0.0			1121.7	1.9	1123.5	
cis-1,3-dichloropropene	0.0	0.0	0.0			0.0			0.8	0.0	0.8	
Trichloroethylene	5.6	0.0	5.6			0.0			6.6	0.0	6.6	
Benzene	555.3	69.6	596.9			0.0			3604.8	10.1	3586.9	
Chlorodibromomethane	29.7	0.0	29.7			0.0			40.3	0.0	40.3	
1,1,2-trichloroethane	0.4	0.0	0.4			0.0			0.0	0.0	0.0	
trans-1,3-dichloropropene	0.0	0.0	0.0			0.0			0.0	0.0	0.0	
2-chloroethyl vinyl ether	64.8	0.0	47.8			0.0			0.0	0.0	0.0	
Bromoform	16.2	0.0	16.2			0.0			8.8	0.0	8.8	
1,1,2,2-tetrachloroethane	1.0	0.0	1.0			0.0			0.5	0.0	0.5	
1,1,2,2-Tetrachloroethylene	8.8	0.0	8.8			1.5			5.8	0.0	5.8	
Toluene	22.0	2.9	25.0			2.5			38.1	1.9	40.0	
Chlorobenzene	41.8	0.0	41.8			0.0			22.5	0.0	22.5	
Ethylbenzene	5.1	1.8	6.9			1.4			4.8	0.2	5.0	

TABLE B-1 (Continued)

Compound	RUN 6 PAIR 1 TENAX	TNX/CHA	TOTAL	GAS VOL. STD (L)	PAIR 2 TENAX	TNX/CHA	TOTAL	GAS VOL. STD (L)	PAIR 3 TENAX	TNX/CHA	TOTAL	GAS VOL STD (L)
Gas volume				11.3				11.1				12.2
C3H4	0.0	0.0	0.0			0.0			0.0	46.3	46.3	
Acetaldehyde	33.4	0.0	33.4			0.0			0.0	0.0	0.0	
Dimethyl Ether	0.0	62.7	44.5			4.6			0.0	0.0	0.0	
Dichlorodifluoromethane	0.0	0.0	0.0			11.9			0.0	9.8	9.8	
Acetonitrile	0.0	0.0	0.0			0.0			5.1	0.0	5.1	
Polyfluoroalkane	0.0	0.0	0.0			0.0			0.0	0.0	0.0	
C4H10	0.0	0.0	0.0			0.0			0.0	0.0	0.0	
Dichlorotetrafluoroethane(a)	0.0	0.0	0.0			0.0			0.0	0.0	0.0	
C4H8/Acetone	307.6	37.3	130.8			27.6			198.1	152.6	136.7	
CHO Compound	0.0	0.0	0.0			0.0			0.0	0.0	0.0	
Carbon Disulfide	10.6	0.0	10.6			0.0			18.7	0.0	18.7	
Chloropropene	0.0	0.0	0.0			0.0			0.0	0.0	0.0	
CHO Compound	0.0	0.0	0.0			0.0			0.0	0.0	0.0	
Bromochloromethane	767.5	0.0	767.5			0.0			123.3	0.0	123.3	
Tetrahydrofuran/C5H12	19.9	0.0	19.9			0.0			0.0	0.0	0.0	
C5H8/C5H10	0.0	0.0	0.0			0.0			0.0	0.0	0.0	
C5H6	0.0	0.0	0.0			0.0			0.0	0.0	0.0	
Trichlorotrifluoroethane(a)	0.0	0.0	0.0			0.0			0.0	0.0	0.0	
C5H12/C6H12	8.5	0.0	8.5			0.0			0.0	0.0	0.0	
1,4-Dioxane(a)	0.0	0.0	0.0			0.0			0.0	0.0	0.0	
C6H12/C6H14	0.0	0.0	0.0			0.0			0.0	0.0	0.0	
C5H12O2	0.0	0.0	0.0			33.8			54.1	38.1	92.2	
C6H12	0.0	0.0	0.0			0.0			0.0	0.0	0.0	
Dichloroacetonitrile	0.0	0.0	0.0			0.0			0.0	0.0	0.0	
C7H14/C6H12	0.0	0.0	0.0			0.0			0.0	0.0	0.0	
hydrocarbon	0.0	0.0	0.0			0.0			0.0	0.0	0.0	
C7H14/C7H16	0.0	0.0	0.0			0.0			0.0	0.0	0.0	
CHO Compound	0.0	0.0	0.0			0.0			0.0	0.0	0.0	
C7H14/C7H16	0.0	0.0	0.0			0.0			13.6	0.0	13.6	
C6H12	22.4	6.9	29.3			0.0			0.0	7.0	7.0	
C7H14/C7H16	22.4	0.0	22.4			0.0			0.0	0.0	0.0	
hydrocarbon	0.0	0.0	0.0			0.0			0.0	0.0	0.0	
C7H12	18.0	0.0	18.0			0.0			10.8	0.0	10.8	
C7H16	0.0	0.0	0.0			0.0			0.0	0.0	0.0	
hydrocarbon/Polyfluoroalkane	0.0	0.0	0.0			0.0			0.0	0.0	0.0	
Polyfluoroalkane	0.0	0.0	0.0			0.0			0.0	0.0	0.0	
Isooctane	0.0	0.0	0.0			0.0			0.0	0.0	0.0	
hydrocarbon	0.0	0.0	0.0			0.0			0.0	0.0	0.0	
hydrocarbon	0.0	0.0	0.0			0.0			0.0	0.0	0.0	

TABLE B-1 (Continued)

Compound	Audit 15162 PAIR 1 TENAX	TNX/CHA	TOTAL	GAS VOL. STD (L)	PAIR 2 TENAX	TNX/CHA	TOTAL	GAS VOL. STD (L)	PAIR 3 TENAX	TNX/CHA	TOTAL	GAS VOL STD (L)
Methyl chloride	24.8	23.2	48.0	10.5	0.0	5.1	5.1	10.9		7.4		10.7
Methyl bromide	8.4	8.1	16.5		0.0	0.0	0.0			0.0		
Vinyl chloride	0.0	0.0	0.0		0.0	0.0	0.0			0.0		
Chloroethane	0.0	0.0	0.0		0.0	0.0	0.0			0.0		
Dichloromethane	67.7	5.1	0.0		107.0	7.0	29.0			0.0		
Trichlorofluoromethane	5.1	2.2	0.0		6.4	2.5	0.0			0.0		
1,1 dichloroethylene	643.9	25.9	669.7		622.5	11.3	633.9			42.0		
1,1 dichloroethane	0.0	0.0	0.0		0.0	0.0	0.0			0.0		
trans-1,2-dichloroethylene	0.0	0.0	0.0		0.0	0.0	0.0			0.0		
Chloroform	4.9	0.0	4.9		1.3	0.0	1.3			0.0		
1,2 dichloroethane	0.0	0.0	0.0		0.0	0.0	0.0			0.0		
1,1,1 trichloroethane	1.6	0.9	2.5		3.0	0.0	3.0			0.0		
Carbon tetrachloride	2.0	0.0	2.0		2.7	0.0	2.7			0.0		
Dichlorobromomethane	0.7	0.0	0.7		0.0	0.0	0.0			0.0		
1,2 dichloropropane	0.0	0.0	0.0		0.0	0.0	0.0			0.0		
cis-1,3-dichloropropene	0.0	0.0	0.0		0.0	0.0	0.0			0.0		
Trichloroethylene	0.0	0.1	0.1		3.2	2.2	5.3			0.0		
Benzene	47.7	8.1	27.8		61.4	8.0	41.4			17.5		
Chlorodibromomethane	0.0	0.0	0.0		0.0	0.0	0.0			0.0		
1,1,2-trichloroethane	0.0	0.0	0.0		0.0	0.0	0.0			0.0		
trans-1,3-dichloropropene	0.0	0.0	0.0		0.0	0.0	0.0			0.0		
2-chloroethyl vinyl ether	13.2	0.0	0.0		75.2	0.0	58.2			0.0		
Bromoform	0.0	0.0	0.0		0.0	0.0	0.0			0.0		
1,1,2,2-tetrachloroethane	0.0	0.0	0.0		3.3	0.0	3.3			0.0		
1,1,2,2-Tetrachloroethylene	0.0	0.0	0.0		6.0	0.0	6.0			0.0		
Toluene	646.2	22.1	668.3		677.2	2.9	680.1			825.9		
Chlorobenzene	704.3	55.9	760.2		1599.4	9.1	1608.4			913.0		
Ethylbenzene	0.5	0.3	0.8		4.5	0.2	4.7			0.7		

TABLE B-1 (Continued)

	Audit 15162 PAIR 1			GAS VOL. STD	PAIR 2			GAS VOL. STD	PAIR 3			GAS VOL STD
Compound	TENAX	TNX/CHA	TOTAL	(L)	TENAX	TNX/CHA	TOTAL	(L)	TENAX	TNX/CHA	TOTAL	(L)
Gas volume				10.5				10.9				10.7
C3H4	0.0	0.0	0.0		0.0	0.0	0.0			0.0		
Acetaldehyde	0.0	0.0	0.0		0.0	0.0	0.0			0.0		
Dimethyl Ether	0.0	37.1	18.9		0.0	0.0	0.0			0.0		
Dichlorodifluoromethane	0.0	0.0	0.0		0.0	0.0	0.0			0.0		
Acetonitrile	0.0	0.0	0.0		0.0	0.0	0.0			0.0		
Polyfluoroalkane	0.0	0.0	0.0		0.0	0.0	0.0			0.0		
C4H10	0.0	0.0	0.0		0.0	0.0	0.0			0.0		
Dichlorotetrafluoroethane(a)	0.0	749.4	749.4		0.0	992.2	992.2			828.7		
C4H8/Acetone	221.3	259.7	267.0		283.2	0.0	69.2			0.0		
CHO Compound	0.0	0.0	0.0		0.0	0.0	0.0			0.0		
Carbon Disulfide	0.0	0.0	0.0		0.0	0.0	0.0			0.0		
Chloropropene	0.0	0.0	0.0		0.0	0.0	0.0			0.0		
CHO Compound	0.0	0.0	0.0		0.0	0.0	0.0			0.0		
Bromochloromethane	0.0	0.0	0.0		0.0	0.0	0.0			0.0		
Tetrahydrofuran/C5H12	0.0	0.0	0.0		0.0	0.0	0.0			0.0		
C5H8/C5H10	0.0	0.0	0.0		0.0	0.0	0.0			0.0		
C5H6	0.0	0.0	0.0		0.0	0.0	0.0			0.0		
Trichlorotrifluoroethane(a)	266.6	583.3	850.0		262.7	602.0	864.7			520.8		
C5H12/C6H12	0.0	0.0	0.0		0.0	0.0	0.0			0.0		
1,4-Dioxane(a)	0.0	0.0	0.0		0.0	26.9	26.9			12.1		
C6H12/C6H14	72.4	10.0	82.4		19.7	0.0	19.7			0.0		
C5H12O2	0.0	0.0	0.0		0.0	0.0	0.0			0.0		
C6H12	0.0	0.0	0.0		0.0	0.0	0.0			0.0		
Dichloroacetonitrile	0.0	0.0	0.0		0.0	0.0	0.0			0.0		
C7H14/C6H12	0.0	0.0	0.0		0.0	0.0	0.0			0.0		
hydrocarbon	0.0	0.0	0.0		0.0	0.0	0.0			0.0		
C7H14/C7H16	0.0	0.0	0.0		0.0	0.0	0.0			0.0		
CHO Compound	0.0	0.0	0.0		0.0	0.0	0.0			0.0		
C7H14/C7H16	0.0	0.0	0.0		0.0	0.0	0.0			0.0		
C6H12	0.0	0.0	0.0		0.0	0.0	0.0			0.0		
C7H14/C7H16	0.0	0.0	0.0		0.0	0.0	0.0			0.0		
hydrocarbon	0.0	0.0	0.0		0.0	0.0	0.0			0.0		
C7H12	0.0	0.0	0.0		0.0	0.0	0.0			0.0		
C7H16	0.0	0.0	0.0		0.0	0.0	0.0			0.0		
hydrocarbon/Polyfluoroalkane	0.0	0.0	0.0		0.0	0.0	0.0			0.0		
Polyfluoroalkane	0.0	0.0	0.0		0.0	0.0	0.0			0.0		
Isooctane	0.0	0.0	0.0		0.0	0.0	0.0			0.0		
hydrocarbon	0.0	0.0	0.0		0.0	0.0	0.0			0.0		
hydrocarbon	0.0	0.0	0.0		0.0	0.0	0.0			0.0		

TABLE B-1 (Continued)

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	PAIR 1			GAS VOL. STD (L)	PAIR 2			GAS VOL. STD (L)	PAIR 3			GAS VOL STD (L)
Compound	TENAX	TNX/CHA	TOTAL		TENAX	TNX/CHA	TOTAL		TENAX	TNX/CHA	TOTAL	
Methyl chloride	2.3	124.4	126.7	10.6	2.4	3.5	5.9	10.8	74.0	44.7	118.6	10.8
Methyl bromide	0.0	0.0	0.0		0.0	2.6	2.6		2.2	2.4	4.6	
Vinyl chloride	209.6	1109.2	1318.8		170.2	232.1	402.3		131.0	993.6	1124.5	
Chloroethane	0.0	0.0	0.0		0.0	0.0	0.0		5.0	0.0	5.0	
Dichloromethane	12.8	3.9	0.0		15.3	1.7	0.0		35.1	18.2	0.0	
Trichlorofluoromethane	10.1	16.2	12.7		2.8	0.0	0.0		26.9	14.5	27.9	
1,1 dichloroethylene	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
1,1 dichloroethane	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
trans-1,2-dichloroethylene	0.0	0.7	0.7		0.0	0.0	0.0		0.0	0.0	0.0	
Chloroform	6341.7	7.6	6349.3		5379.0	17.5	5396.5		5382.1	5.5	5387.6	
1,2 dichloroethane	0.0	0.0	0.0		0.0	0.0	0.0		2.1	0.0	2.1	
1,1,1 trichloroethane	4.0	1.8	5.8		1.2	0.0	1.2		2.3	0.0	2.3	
Carbon tetrachloride	1423.0	124.8	1547.7		1126.3	150.5	1276.8		1221.2	47.6	1268.7	
Dichlorobromomethane	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
1,2 dichloropropane	0.0	0.0	0.0		0.0	0.0	0.0		0.3	0.0	0.3	
cis-1,3-dichloropropene	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
Trichloroethylene	0.2	0.0	0.2		0.0	0.7	0.7		2.1	0.1	2.2	
Benzene	1813.1	6.8	1792.0		1533.2	9.3	1514.4		1413.3	20.0	1405.3	
Chlorodibromomethane	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
1,1,2-trichloroethane	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
trans-1,3-dichloropropene	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
2-chloroethyl vinyl ether	0.0	35.1	18.1		23.7	0.0	6.7		28.7	35.6	47.3	
Bromoform	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
1,1,2,2-tetrachloroethane	18.3	0.0	18.3		15.3	0.2	15.5		18.8	0.6	19.4	
1,1,2,2-Tetrachloroethylene	1257.2	9.3	1266.5		1074.9	8.3	1083.2		884.0	9.5	893.5	
Toluene	7.3	2.0	9.4		8.6	1.3	9.8		6.6	1.6	8.1	
Chlorobenzene	5.6	1.3	6.9		1.9	1.0	3.0		3.4	0.0	3.4	
Ethylbenzene	0.2	0.2	0.5		2.4	0.9	3.2		5.2	1.2	6.4	

TABLE B-1 (Continued)

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Compound	PAIR 1 TENAX	TNX/CHA	TOTAL	GAS VOL. STD (L)	PAIR 2 TENAX	TNX/CHA	TOTAL	GAS VOL. STD (L)	PAIR 3 TENAX	TNX/CHA	TOTAL	GAS VOL STD (L)
Gas volume				10.6				10.8				10.8
C3H4	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
Acetaldehyde	0.0	0.0	0.0		0.0	0.0	0.0		8.3	0.0	8.3	
Dimethyl Ether	0.0	0.0	0.0		0.0	0.0	0.0		0.0	21.6	3.4	
Dichlorodifluoromethane	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
Acetonitrile	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
Polyfluoroalkane	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
C4H10	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
Dichlorotetrafluoroethane(a)	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
C4H8/Acetone	57.0	74.6	0.0		107.6	114.4	7.0		80.5	96.5	0.0	
CHO Compound	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
Carbon Disulfide	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
Chloropropene	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
CHO Compound	0.0	0.0	0.0		0.0	0.0	0.0		32.6	0.0	32.6	
Bromochloromethane	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
Tetrahydrofuran/C5H12	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
C5H8/C5H10	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
C5H6	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
Trichlorotrifluoroethane(a)	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
C5H12/C6H12	0.0	0.0	0.0		0.0	0.0	0.0		9.0	0.0	9.0	
1,4-Dioxane(a)	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
C6H12/C6H14	16.5	16.0	32.5		83.8	0.0	83.8		46.4	12.3	58.7	
C5H12O2	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
C6H12	0.0	0.0	0.0		0.0	0.0	0.0		9.9	0.0	9.9	
Dichloroacetonitrile	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
C7H14/C6H12	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
hydrocarbon	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
C7H14/C7H16	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
CHO Compound	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
C7H14/C7H16	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
C6H12	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
C7H14/C7H16	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
hydrocarbon	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
C7H12	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
C7H16	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
hydrocarbon/Polyfluoroalkane	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
Polyfluoroalkane	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
Isooctane	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
hydrocarbon	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	
hydrocarbon	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	

TABLE B-2. AVERAGE VOLATILE EMISSIONS (ng/L)

	EMISSIONS (ng/L)							
Compound	RUN 1	RUN 2	RUN 3	RUN 4	RUN 5	RUN 6	Audit 15162	Audit 11948
Methyl chloride	9.3	0.0	3.6	10.5	98.5	227.2	2.5	7.8
Methyl bromide	0.2	0.1	0.6	9.2	14.9	16.5	0.8	0.2
Vinyl chloride	2.2	0.0	1.7	1.9	4.6	7.3	0.0	88.8
Chloroethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
Dichloromethane	8.2	0.0	3.5	11.2	519.7	311.4	1.3	0.0
Trichlorofluoromethane	23.3	0.0	0.3	0.3	1.0	3.2	0.0	1.3
1,1 dichloroethylene	4.0	0.0	0.2	0.5	1.1	1.0	61.1	0.0
1,1 dichloroethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
trans-1,2-dichloroethylene	0.0	0.0	0.0	0.0	0.3	0.3	0.0	0.0
Chloroform	311.0	1.2	321.1	359.9	120.4	87.4	0.3	533.2
1,2 dichloroethane	10.5	0.1	0.9	2.2	0.4	1.9	0.0	0.1
1,1,1 trichloroethane	1.4	1.4	6.4	4.1	2.2	1.2	0.3	0.3
Carbon tetrachloride	24.5	0.3	8.0	46.5	73.4	21.4	0.2	127.4
Dichlorobromomethane	95.5	0.1	91.1	109.7	8.1	20.2	0.0	0.0
1,2 dichloropropane	5.8	0.0	0.0	0.2	0.1	53.9	0.0	0.0
cis-1,3-dichloropropene	0.2	0.0	0.1	0.0	0.0	0.0	0.0	0.0
Trichloroethylene	0.3	0.0	0.5	0.4	0.5	0.5	0.2	0.1
Benzene	14.6	1.5	5.4	196.2	60.3	173.3	3.2	146.7
Chlorodibromomethane	19.8	0.0	14.9	40.4	4.7	3.0	0.0	0.0
1,1,2-trichloroethane	0.2	0.0	0.0	0.1	0.1	0.0	0.0	0.0
trans-1,3-dichloropropene	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
2-chloroethyl vinyl ether	7.8	0.7	0.9	4.4	8.3	2.1	2.7	2.2
Bromoform	1.5	0.0	0.3	66.7	6.7	1.1	0.0	0.0
1,1,2,2-tetrachloroethane	0.4	0.0	0.2	0.1	0.2	0.1	0.1	1.7
1,1,2,2-Tetrachloroethylene	8.3	0.3	2.8	1.7	1.1	0.6	0.3	101.0
Toluene	30.2	0.6	3.6	6.4	3.5	2.7	63.1	0.9
Chlorobenzene	0.5	0.0	0.4	2.6	2.7	2.8	110.1	0.4
Ethylbenzene	4.5	0.2	0.6	3.5	0.8	0.5	0.3	0.3

TABLE B-2 (Continued)

	EMISSIONS (ng/L)							
Compound	RUN 1	RUN 2	RUN 3	RUN 4	RUN 5	RUN 6	Audit 15162	Audit 11948
Gas volume								
C3H4	0.0	0.0	0.0	1.0	0.0	1.9	0.0	0.0
Acetaldehyde	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.3
Dimethyl Ether	35.8	0.4	0.7	1.9	1.7	2.0	0.9	0.1
Dichlorodifluoromethane	0.7	0.0	0.8	0.4	0.6	0.4	0.0	0.0
Acetonitrile	0.0	0.0	0.2	0.7	0.8	0.2	0.0	0.0
Polyfluoroalkane	4.5	0.0	0.8	0.0	0.0	0.0	0.0	0.0
C4H10	0.0	0.0	0.5	2.0	0.0	0.0	0.0	0.0
Dichlorotetrafluoroethane(a)	0.0	0.0	0.0	0.0	0.0	0.0	81.2	0.0
C4H8/Acetone	9.8	12.7	8.1	17.1	10.8	11.4	15.9	0.2
CHO Compound	0.0	0.7	0.2	0.0	0.0	0.0	0.0	0.0
Carbon Disulfide	0.7	0.0	0.5	1.7	0.5	1.2	0.0	0.0
Chloropropene	0.0	0.0	0.7	1.1	0.0	0.0	0.0	0.0
CHO Compound	0.0	0.0	0.0	0.0	0.5	0.0	0.0	1.0
Bromochloromethane	0.0	0.0	0.0	0.0	6.3	39.0	0.0	0.0
Tetrahydrofuran/C5H12	1.2	0.7	0.2	1.5	0.7	0.9	0.0	0.0
C5H8/C5H10	0.0	0.0	0.6	0.0	0.9	0.0	0.0	0.0
C5H6	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0
Trichlorotrifluoroethane(a)	0.0	0.0	0.0	0.0	0.0	0.0	80.1	0.0
C5H12/C6H12	2.8	1.0	0.8	0.0	0.4	0.4	0.0	0.3
1,4-Dioxane(a)	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.0
C6H12/C6H14	6.5	0.5	0.4	1.8	3.9	0.0	4.8	5.4
C5H12O2	0.0	0.0	0.0	0.0	0.7	3.8	0.0	0.0
C6H12	0.7	0.0	0.0	0.0	0.4	0.0	0.0	0.3
Dichloroacetonitrile	14.5	0.0	3.0	2.8	1.5	0.0	0.0	0.0
C7H14/C6H12	0.0	0.0	0.4	0.0	0.9	0.0	0.0	0.0
hydrocarbon	0.0	0.0	0.0	5.8	0.0	0.0	0.0	0.0
C7H14/C7H16	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHO Compound	0.0	1.1	0.0	0.0	0.0	0.0	0.0	0.0
C7H14/C7H16	29.3	0.0	1.5	0.0	0.0	0.6	0.0	0.0
C6H12	0.0	0.0	0.3	0.0	0.4	1.6	0.0	0.0
C7H14/C7H16	4.4	0.0	0.4	5.9	1.0	1.0	0.0	0.0
hydrocarbon	0.5	1.0	0.5	0.4	0.4	0.0	0.0	0.0
C7H12	0.0	0.0	0.0	1.4	1.4	1.2	0.0	0.0
C7H16	7.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
hydrocarbon/Polyfluoroalkane	0.0	0.0	0.7	0.5	0.0	0.0	0.0	0.0
Polyfluoroalkane	0.0	0.0	0.8	1.3	0.0	0.0	0.0	0.0
Isooctane	5.8	0.0	3.6	206.6	17.2	0.0	0.0	0.0
hydrocarbon	5.5	0.0	0.6	5.2	0.0	0.0	0.0	0.0
hydrocarbon	7.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	140.0	18.0	26.3	258.1	51.3	65.1	184.2	7.6

TABLE B-3. AVERAGE VOLATILE EMISSIONS (ppb)

		EMISSIONS (PPB)							
	FACTOR							Audit	Audit
Compound	(div)	RUN 1	RUN 2	RUN 3	RUN 4	RUN 5	RUN 6	15162	11948
Methyl chloride	2.1	4.4	0.0	1.7	5.0	46.9	108.2	1.2	3.7
Methyl bromide	3.9	0.0	0.0	0.1	2.4	3.8	4.2	0.2	0.1
Vinyl chloride	2.6	0.9	0.0	0.6	0.7	1.8	2.8	0.0	34.1
Chloroethane	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Dichloromethane	3.5	2.4	0.0	1.0	3.2	148.5	89.0	0.4	0.0
Trichlorofluoromethane	5.7	4.1	0.0	0.1	0.1	0.2	0.6	0.0	0.2
1,1 dichloroethylene	4.0	1.0	0.0	0.0	0.1	0.3	0.3	15.3	0.0
1,1 dichloroethane	4.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
trans-1,2-dichloroethylene	4.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0
Chloroform	5.0	62.2	0.2	64.2	72.0	24.1	17.5	0.1	106.6
1,2 dichloroethane	4.1	2.6	0.0	0.2	0.5	0.1	0.5	0.0	0.0
1,1,1 trichloroethane	5.5	0.2	0.3	1.2	0.7	0.4	0.2	0.0	0.1
Carbon tetrachloride	6.4	3.8	0.0	1.3	7.3	11.5	3.3	0.0	19.9
Dichlorobromomethane	6.8	14.0	0.0	13.4	16.1	1.2	3.0	0.0	0.0
1,2 dichloropropane	4.7	1.2	0.0	0.0	0.0	0.0	11.5	0.0	0.0
cis-1,3-dichloropropene	4.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Trichloroethylene	5.5	0.1	0.0	0.1	0.1	0.1	0.1	0.0	0.0
Benzene	3.2	4.6	0.5	1.7	61.3	18.9	54.1	1.0	45.8
Chlorodibromomethane	8.7	2.3	0.0	1.7	4.6	0.5	0.3	0.0	0.0
1,1,2-trichloroethane	5.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
trans-1,3-dichloropropene	4.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-chloroethyl vinyl ether	4.4	1.8	0.2	0.2	1.0	1.9	0.5	0.6	0.5
Bromoform	10.5	0.1	0.0	0.0	6.3	0.6	0.1	0.0	0.0
1,1,2,2-tetrachloroethane	7.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.2
1,1,2,2-Tetrachloroethylene	6.9	1.2	0.0	0.4	0.3	0.2	0.1	0.0	14.6
Toluene	3.8	7.9	0.1	0.9	1.7	0.9	0.7	16.6	0.2
Chlorobenzene	4.7	0.1	0.0	0.1	0.6	0.6	0.6	23.4	0.1
Ethylbenzene	4.4	1.0	0.0	0.1	0.8	0.2	0.1	0.1	0.1
	TOTAL	111.7	1.4	87.5	179.9	215.8	189.6	57.8	222.7

TABLE B-3 (Continued)

	FACTOR	EMISSIONS (PPB)						Audit	Audit
Compound	(div)	RUN 1	RUN 2	RUN 3	RUN 4	RUN 5	RUN 6	15162	11948
Gas volume									
C3H4	1.7	0.0	0.0	0.0	0.6	0.0	1.1	0.0	0.0
Acetaldehyde	1.8	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.1
Dimethyl Ether	1.9	18.8	0.2	0.3	1.0	0.9	1.0	0.5	0.1
Dichlorodifluoromethane	4.3	0.2	0.0	0.2	0.1	0.1	0.1	0.0	0.0
Acetonitrile	1.7	0.0	0.0	0.1	0.4	0.5	0.1	0.0	0.0
Polyfluoroalkane	2.9	1.6	0.0	0.3	0.0	0.0	0.0	0.0	0.0
C4H10	2.4	0.0	0.0	0.2	0.8	0.0	0.0	0.0	0.0
Dichlorotetrafluoroethane(a)	7.1	0.0	0.0	0.0	0.0	0.0	0.0	11.4	0.0
C4H8/Acetone	2.4	4.1	5.3	3.4	7.1	4.5	4.7	6.6	0.1
CHO Compound	2.4	0.0	0.3	0.1	0.0	0.0	0.0	0.0	0.0
Carbon Disulfide	3.2	0.2	0.0	0.1	0.5	0.2	0.4	0.0	0.0
Chloropropene	3.2	0.0	0.0	0.2	0.3	0.0	0.0	0.0	0.0
CHO Compound	3.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.3
Bromochloromethane	5.4	0.0	0.0	0.0	0.0	1.2	7.2	0.0	0.0
Tetrahydrofuran/C5H12	3.0	0.4	0.2	0.1	0.5	0.2	0.3	0.0	0.0
C5H8/C5H10	2.9	0.0	0.0	0.2	0.0	0.3	0.0	0.0	0.0
C5H6	2.7	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Trichlorotrifluoroethane(a)	7.8	0.0	0.0	0.0	0.0	0.0	0.0	10.3	0.0
C5H12/C6H12	3.5	0.8	0.3	0.2	0.0	0.1	0.1	0.0	0.1
1,4-Dioxane(a)	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0
C6H12/C6H14	3.6	1.8	0.1	0.1	0.5	1.1	0.0	1.3	1.5
C5H12O2	4.3	0.0	0.0	0.0	0.0	0.2	0.9	0.0	0.0
C6H12	3.5	0.2	0.0	0.0	0.0	0.1	0.0	0.0	0.1
Dichloroacetonitrile	4.6	3.2	0.0	0.6	0.6	0.3	0.0	0.0	0.0
C7H14/C6H12	4.1	0.0	0.0	0.1	0.0	0.2	0.0	0.0	0.0
hydrocarbon	4.1	0.0	0.0	0.0	1.4	0.0	0.0	0.0	0.0
C7H14/C7H16	4.1	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHO Compound	3.6	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0
C7H14/C7H16	4.1	7.2	0.0	0.4	0.0	0.0	0.1	0.0	0.0
C6H12	3.5	0.0	0.0	0.1	0.0	0.1	0.5	0.0	0.0
C7H14/C7H16	4.1	1.1	0.0	0.1	1.4	0.2	0.2	0.0	0.0
hydrocarbon	4.1	0.1	0.2	0.1	0.1	0.1	0.0	0.0	0.0
C7H12	4.0	0.0	0.0	0.0	0.4	0.4	0.3	0.0	0.0
C7H16	4.1	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
hydrocarbon/Polyfluoroalkane	4.1	0.0	0.0	0.2	0.1	0.0	0.0	0.0	0.0
Polyfluoroalkane	6.1	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.0
Isooctane	4.7	1.2	0.0	0.8	44.0	3.7	0.0	0.0	0.0
hydrocarbon	4.7	1.2	0.0	0.1	1.1	0.0	0.0	0.0	0.0
hydrocarbon	4.7	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TOTAL	46.0	7.0	8.2	60.6	14.7	16.8	30.5	2.3

TABLE B-4. AVERAGE VOLATILE EMISSIONS
(ppb methane)

		EMISSIONS (PPB METHANE)					
	FACTOR						
Compound	(mult)	RUN 1	RUN 2	RUN 3	RUN 4	RUN 5	RUN 6
Methyl chloride	0.95	4.2	0.0	1.6	4.8	44.6	102.8
Methyl bromide	0.95	0.0	0.0	0.1	2.2	3.6	4.0
Vinyl chloride	1.75	1.5	0.0	1.1	1.2	3.1	4.9
Chloroethane	1.85	0.0	0.0	0.0	0.0	0.0	0.0
Dichloromethane	0.90	2.1	0.0	0.9	2.9	133.6	80.1
Trichlorofluoromethane	0.45	1.8	0.0	0.0	0.0	0.1	0.3
1,1 dichloroethylene	1.60	1.6	0.0	0.1	0.2	0.4	0.4
1,1 dichloroethane	1.70	0.0	0.0	0.0	0.0	0.0	0.0
trans-1,2-dichloroethylene	1.60	0.0	0.0	0.0	0.0	0.1	0.1
Chloroform	0.85	52.9	0.2	54.6	61.2	20.5	14.9
1,2 dichloroethane	1.60	4.1	0.0	0.3	0.9	0.2	0.8
1,1,1 trichloroethane	1.50	0.4	0.4	1.8	1.1	0.6	0.3
Carbon tetrachloride	0.64	2.5	0.0	0.8	4.7	7.3	2.1
Dichlorobromomethane	0.85	11.9	0.0	11.4	13.7	1.0	2.5
1,2 dichloropropane	2.90	3.6	0.0	0.0	0.1	0.0	33.3
cis-1,3-dichloropropene	2.80	0.1	0.0	0.1	0.0	0.0	0.0
Trichloroethylene	1.50	0.1	0.0	0.1	0.1	0.1	0.1
Benzene	6.00	27.4	2.7	10.1	367.9	113.1	324.9
Chlorodibromomethane	0.85	1.9	0.0	1.5	4.0	0.5	0.3
1,1,2-trichloroethane	1.50	0.1	0.0	0.0	0.0	0.0	0.0
trans-1,3-dichloropropene	2.80	0.0	0.0	0.1	0.0	0.0	0.0
2-chloroethyl vinyl ether	3.20	5.7	0.5	0.6	3.2	6.0	1.5
Bromoform	0.85	0.1	0.0	0.0	5.4	0.5	0.1
1,1,2,2-tetrachloroethane	1.20	0.1	0.0	0.0	0.0	0.0	0.0
1,1,2,2-Tetrachloroethylene	1.10	1.3	0.0	0.4	0.3	0.2	0.1
Toluene	7.00	55.6	1.0	6.5	11.7	6.4	5.1
Chlorobenzene	6.00	0.7	0.0	0.5	3.4	3.4	3.5
Ethylbenzene	8.00	8.2	0.3	1.1	6.3	1.5	0.9
		183.8	5.3	92.2	490.7	302.6	480.3

TABLE B-4 (Continued)

		EMISSIONS (PPB METHANE)					
Compound	FACTOR (mult)	RUN 1	RUN 2	RUN 3	RUN 4	RUN 5	RUN 6
Gas volume							
C3H4	3.00	0.0	0.0	0.0	1.7	0.0	3.3
Acetaldehyde	1.00	0.0	0.0	0.0	0.0	0.0	0.8
Dimethyl Ether	1.50	28.3	0.3	0.5	1.5	1.4	1.6
Dichlorodifluoromethane	0.60	0.1	0.0	0.1	0.1	0.1	0.1
Acetonitrile	1.30	0.0	0.0	0.2	0.5	0.6	0.2
Polyfluoroalkane	0.80	1.3	0.0	0.2	0.0	0.0	0.0
C4H10	4.00	0.0	0.0	0.8	3.3	0.0	0.0
Dichlorotetrafluoroethane(a)	0.20	0.0	0.0	0.0	0.0	0.0	0.0
C4H8/Acetone	2.00	8.2	10.6	6.8	14.3	9.0	9.5
CHO Compound	2.00	0.0	0.6	0.2	0.0	0.0	0.0
Carbon Disulfide	0.01	0.0	0.0	0.0	0.0	0.0	0.0
Chloropropene	2.80	0.0	0.0	0.6	0.9	0.0	0.0
CHO Compound	3.00	0.0	0.0	0.0	0.0	0.5	0.0
Bromochloromethane	0.90	0.0	0.0	0.0	0.0	1.0	6.5
Tetrahydrofuran/C5H12	5.00	2.0	1.2	0.3	2.5	1.2	1.5
C5H8/C5H10	5.00	0.0	0.0	1.0	0.0	1.6	0.0
C5H6	5.00	0.0	0.0	0.0	0.0	0.7	0.0
Trichlorotrifluoroethane(a)	0.20	0.0	0.0	0.0	0.0	0.0	0.0
C5H12/C6H12	5.00	4.1	1.4	1.2	0.0	0.5	0.5
1,4-Dioxane(a)	3.00	0.0	0.0	0.0	0.0	0.0	0.0
C6H12/C6H14	6.00	10.8	0.9	0.6	3.0	6.5	0.0
C5H12O2	4.00	0.0	0.0	0.0	0.0	0.6	3.5
C6H12	6.00	1.3	0.0	0.0	0.0	0.6	0.0
Dichloroacetonitrile	1.10	3.5	0.0	0.7	0.7	0.3	0.0
C7H14/C6H12	7.00	0.0	0.0	0.7	0.0	1.5	0.0
hydrocarbon	7.00	0.0	0.0	0.0	10.0	0.0	0.0
C7H14/C7H16	7.00	2.5	0.0	0.0	0.0	0.0	0.0
CHO Compound	4.00	0.0	1.2	0.0	0.0	0.0	0.0
C7H14/C7H16	7.00	50.1	0.0	2.6	0.0	0.0	0.9
C6H12	6.00	0.0	0.0	0.5	0.0	0.6	2.7
C7H14/C7H16	7.00	7.5	0.0	0.7	10.1	1.6	1.7
hydrocarbon	7.00	0.9	1.7	0.8	0.6	0.6	0.0
C7H12	7.00	0.0	0.0	0.0	2.5	2.5	2.2
C7H16	7.00	13.5	0.0	0.0	0.0	0.0	0.0
hydrocarbon/Polyfluoroalkane	7.00	0.0	0.0	1.2	0.9	0.0	0.0
Polyfluoroalkane	6.00	0.0	0.0	0.8	1.3	0.0	0.0
Isooctane	8.00	9.9	0.0	6.2	351.6	29.3	0.0
hydrocarbon	8.00	9.3	0.0	1.0	8.8	0.0	0.0
hydrocarbon	8.00	13.3	0.0	0.0	0.0	0.0	0.0
		166.2	17.7	27.7	412.5	61.0	31.6

SEMIVOLATILE ORGANIC STACK DATA

Raw data for the semivolatiles is presented in Table B-5. This table shows the amounts of each compound detected (μg) after having corrected for those compounds found at significant levels in the blanks. Similar species have been grouped together into six categories: oxygenated aliphatic hydrocarbons, aliphatic hydrocarbons, aromatic hydrocarbons, halogenated hydrocarbons, nitrogenated hydrocarbons, and unknown constituents.

Table B-6 shows the gas volumes (corrected to standard temperature and pressure) sampled for each run. Division of the values in Table B-6 by the appropriate gas volume results in Table B-7, Stack Concentrations of Semivolatile Constituents.

The values shown in Table B-8 have been corrected for compounds that only appeared during one run. Note that all of the nitrogenated species were detected only during Run 6, and are thus not present in Table B-8.

TABLE B-5. SEMIVOLATILE RAW DATA

TME Semivolatiles Oxygenated Aliphatic Hydrocarbons (ug)

Compound	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6
3-methyl-3-Pentanol	0	0	0	103.57	0	0
sec-Butyl acetate	0	0	0	12.28	0	19.92
3,4-dihydro-6-methyl-2,4-pyran	23.74	0	10.17	0	4.16	7.46
3-Hexanone	0	0	938.72	1059.09	1038.63	802.78
Hexanone Isomers	889.34	0	0	0	0	0
CHO Compounds	0	0	214.73	23.42	59.66	619.49
CHO Compound	0	0	0	0	0	34.96
CHO Compound	0	0	0	365.33	0	0
CHO Compound	0	0	0	676.9	0	0
5-Methyl-5-Hexen-2-One	0	0	0	262.34	0	0
Heptanone Isomer	0	0	36.78	0	0	0
CHO Isomer	0	0	0	912.31	0	0
Acetate	0	0	987.38	0	0	0
CHO Compound	1229.97	0	0	0	0	0
Acetate	0	405.52	0	0	168.08	0
5-Methylhexen-2-one	0	0	186.22	0	290.93	158.97
Acetate	589.63	0	0	0	0	0
Acetate	0	0	0	113.86	0	0
CHO Compound	1572.51	1284.56	560.75	82.42	1027.52	0
CHO Compound	0	390.28	0	42.08	0	0
Carboxylic Acid	0	0	355.05	0	609.23	0
Acetate	0	0	0	0	78.91	81.06
CHO Compound	705.36	0	0	0	0	0
CHO Compound	0	271.23	0	0	0	0
Acetate	0	0	77.36	0	0	71.45
CHO Compound	415.61	0	137.31	0	229.62	78.15
CHO Compound	0	0	0	0	0	61.2
CHO Compound	0	45.24	363.09	0	597.03	600.62
CHO Compound	0	0	0	0	27.7	0
Acetate	0	0	0	0	15.13	0
CHO Compound	0	0	0	50.85	0	0
Carboxylic acid or ester	136.58	0	0	0	0	0
Acetate	0	0	0	0	52.95	0
Acetate	0	0	0	0	94.5	0
CHO Compound	184.26	0	0	0	0	0
CHO Compound	100.86	0	0	70.36	0	80.26
Carboxylic Acid	0	0	181.81	0	0	0
Heptanone Isomer	0	0	0	0	117.91	75.9
Acetate	0	0	0	8.56	0	0
CHO Compound	0	0	49.74	0	0	0
CHO Cmpd/Naphthalene	0	0	0	0	0	0
Carboxylic Acid	183.83	0	0	298.2	0	235.83
C11H24/CHO Compound	274.98	0	0	0	0	0
Acetate	0	0	57.1	0	0	0
CHO Compound	0	0	0	78.68	242.46	0
CHO Compound	0	0	12.15	9.6	0	14.31
CHO Compound	0	0	74.31	42.42	0	57.2
CHO Compound	0	0	0	202.39	162.75	107.6
Acetate	0	0	102.68	89.09	124.7	0
Octyl Acetate	319.34	91.72	0	0	0	0
Carboxylic Acid or Acetate	0	0	0	0	0	88.05
Acetate	0	0	81.62	142.58	293.02	104

TABLE B-5 (Continued)

Compound	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6
CHO Compound	0	0	118.78	0	0	0
CHO Cmpd/Aromatic Cmpd	0	0	0	0	0	19.97
Acetate	0	0	74.98	117.97	61.24	0
CHO Compound	57.63	41.64	0	0	271.3	0
CHO Compound	72.67	0	15.33	24.7	46.78	15.65
Carboxylic Acid	0	37.25	0	0	0	0
Acetate	0	0	0	40.84	0	0
CHO Compound	0	0	0	0	0	36.12
Acetate	339.76	70.9	0	22.61	0	0
CHO Compound	86.2	0	14.26	24.86	30.35	19.27
Carboxylic Acid	0	0	0	0	34.97	0
Decanoic Acid (branched)	0	0	0	0	22.16	0
Acetate	79.79	0	0	0	0	0
Carboxylic Acid	0	0	18.7	0	0	0
CHO Compound	0	33.38	0	0	0	0
CHO Compound	0	0	0	25.31	45.46	0
CHO Compound	138.16	54.39	119.61	102.77	191.71	145.72
CHO Compound	0	0	0	53.49	0	0
Acetate	0	0	0	0	0	40.52
Acetate	0	0	0	8.66	25.3	13.7
CHO Compound	0	0	10.26	0	0	0
CHO Compound	0	0	0	0	25.77	0
Carboxylic Acid/Unknown	0	0	0	0	0	8.81
CHO Compound	0	14.58	15.74	6.76	40.97	0
CHO Compound	0	0	0	0	0	13.14
Carboxylic Acid or Acetate	0	0	0	0	6.5	0
CHO Compound	0	0	12.19	0	0	0
Dodecanoic Acid	127.05	54.33	148.15	115.76	49.48	36.41
CHO Compound	0	0	0	0	23.92	0
CHO Compound	0	0	0	0	7.18	0
CHO Compound	17.46	0	0	0	0	0
CHO Compound	0	0	0	0	9.32	0
CHO Compound	0	0	18.54	17.19	0	0
Carboxylic Acid	13.53	0	0	0	0	0
CHO Compound	0	0	0	7.55	8.42	0
Tetradecanoic Acid	43.02	34.17	58.03	67.88	30.71	29.47
CHO Compound	0	0	0	23.38	0	10.27
Pentadecanoic Acid	0	0	16.15	18.19	24.93	12.54
CHO Compound	9.11	0	0	0	0	0
Carboxylic Acid	4.85	0	0	0	0	0
Pentadecatrienoic Acid	0	12.08	0	25.64	0	0
Hexadecanoic Acid	59.15	105.43	128.84	121.3	104.46	74.83
Dibutyl Phthalate	14.48	0	0	0	0	0
Heptadecanoic Acid	0	0	4.11	0	0	0
CHO Compound	0	0	8.61	0	0	0
CHO Compound	0	0	7.45	0	0	0
Heptadecatrienoic Acid	13.7	22.36	21.33	32.02	19.01	17.45
Nonadecanoic Acid	0	0	0	14.28	0	0
Carboxylic Acid	0	12.96	0	0	0	0
Tributylcitrate	0	0	0	5.19	0	0
CHO Compound	78.32	49.77	62.25	43.96	76.09	58.08
Butyl Octadecanoate	3.65	8.57	0	10.72	0	0
CHO Compound	0	0	0	0	0	8.4
totals	7784.54	3040.36	5300.28	5577.36	6390.92	3859.56

TABLE B-5 (Continued)

TME Semivolatiles — Aliphatic Hydrocarbons (ug)

Compound	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6
Hydrocarbon	0	0	0	0	0	11.01
Hydrocarbon	0	0	0	0	449.03	0
$C_{11}H_{24}$/CHO Compound	274.98	0	0	0	0	0
Hydrocarbon	0	0	0	0	0	95.76
Hydrocarbon	0	90.84	0	0	0	0
$C_{14}H_{30}$	0	0	0	0	52.17	0
Hydrocarbon	0	14.01	0	0	0	0
$C_{14}H_{30}$	35.99	17.29	46.94	15.14	51.82	34.1
$C_{14}H_{28}$	0	0	0	0	19.96	0
Hydrocarbon	0	0	0	0	41.99	0
$C_{15}H_{32}$	0	0	32.26	0	0	0
Hydrocarbon	0	0	11.63	0	0	0
Hydrocarbon	0	0	0	0	7.43	5.02
$C_{16}H_{34}$	11.41	0	0	0	0	0
Hydrocarbon	14.49	0	0	0	11.06	0
Hydrocarbon	13.56	0	0	13.69	0	11.11
Hydrocarbon	13.31	0	0	0	0	0
Hydrocarbon	10.6	0	0	0	0	0
Hydrocarbon	7.97	0	0	0	0	0
Hydrocarbon/unknown	0	0	27.9	0	0	0
totals	382.31	122.14	118.73	28.83	633.46	157

TABLE B-5 (Continued)

TME Semivolatiles Aromatic Hydrocarbons (ug)

Compound	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6
Methyl Benzoate	136.58	0	49.2	0	0	39.13
Aromatic Compound	0	19.69	34.01	0	0	41.23
Oxyg. Aromatic Cmpd.	0	0	0	57.14	0	0
CHO Cmpd./Aromatic Cmpd.	0	0	0	0	0	19.97
Diethyl Phthalate	61.68	16.14	55.54	609.82	40.91	41.63
Phthalate	6.94	0	0	0	0	0
Amide/Phthalate	0	0	0	0	0	6.71
Phthalate	0	0	0	10.64	0	19.6
Phthalate	0	0	0	0	0	4.94
totals	205.2	35.83	138.75	677.6	40.91	173.21

TABLE B-5 (Continued)

TME Semivolatiles Halogenated Hydrocarbons (ug)

Compound	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6
1,1,1-trich.-2-ME-2-prpnol	0	154.74	76.83	0	0	171.57
Chlorocyclohexanol	0	0	0	96.63	0	0
Chlorocyclohexanol	267.15	219.06	0	0	180.44	42.06
CHOCl Cmpd	0	0	0	559.4	0	0
CHOCl Cmpd	566.3	539.67	0	0	0	0
Chlorocyclohexanol	0	0	274.91	0	0	0
Dichloropentane	0	0	0	0	0	90.36
totals	833.45	913.47	351.74	656.03	180.44	303.99

TABLE B-5 (Continued)

TME Semivolatiles	Nitrogenated Hydrocarbons (ug)					
Compound	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6
Hexadecanamide	0	0	0	0	0	13.9
Octadecanamide	0	0	0	0	0	6.15
Amide/Phthalate	0	0	0	0	0	6.71
totals	0	0	0	0	0	26.76

TABLE B-5 (Continued)

TME Semivolatiles Unknown Constituents (ug)

Compound	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6
Unknown	0	0	0	0	9.78	0
Unknown	0	0	18.85	0	77.74	18.17
Unknown	0	0	0	46.47	0	0
Methyl Benzoate/Unknown	0	0	49.2	0	0	0
Unknown	0	138.54	35.72	0	0	0
Unknown	0	121.29	0	38.18	0	0
Unknown	0	0	0	125.89	0	36.2
Unknown	57.29	29.71	46.2	0	0	0
Unknown	0	87.18	0	0	0	0
Unknown	0	192.97	0	0	9.48	0
Unknown	562.01	172.47	0	0	102.41	0
C14H30/Unknown	0	0	32.93	0	0	0
Unknown	0	53.37	0	18.44	0	48.43
Unknown	16.45	16.72	37.95	19.75	0	45.19
Unknown	0	0	15.11	0	30.17	0
Unknown	29.78	0	29.16	0	58.97	0
Unknown	0	0	21.87	0	0	8.3
Unknown	0	0	6.65	0	11.45	0
Carboxylic Acid/Unknown	0	0	0	0	0	8.81
Unknown	30.59	0	0	13.1	18.48	25.13
Unknown/Unknown	0	0	12.29	0	0	0
Unknown	0	0	12.38	0	12.49	8.87
Unknown	0	0	0	0	27.35	0
Unknown	6.34	0	0	0	25.62	8.92
Unknown	0	0	0	0	14.61	0
Unknown	0	0	0	0	0	23.34
Unknown	53.88	0	0	0	0	0
Unknown	0	24.92	0	0	0	0
Unknown	21.71	0	0	0	15.06	22.28
Unknown	14.11	10.8	0	0	0	0
Unknown	24.06	31.27	0	0	0	0
Unknown	0	0	0	0	0	13.69
Unknown	0	0	0	0	21.78	0
Unknown	0	0	7.91	0	10.81	0
Unknown	8.15	0	0	0	11.96	9.01
Unknown	0	0	0	9.08	0	0
Unknown	0	0	0	9.61	0	0
Unknown	0	0	0	0	8.9	0
Unknown	7.7	0	0	0	0	0
Hydrocarbon/Unknown	0	0	27.9	0	0	0
totals	832.07	879.24	354.12	280.52	467.06	276.34

TABLE B-6. MM5 SAMPLE GAS VOLUMES

	Run No.					
	1	2	3	4	5	6
Volume (dscm)	1.517	1.614	1.667	1.675	1.719	1.691

TABLE B-7. STACK CONCENTRATIONS OF SEMIVOLATILE CONSTITUENTS

Oxygenated Aliphatic Hydrocarbons (ug/m3)

Compound	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6
3-methyl-3-Pentanol	0.00	0.00	0.00	61.83	0.00	0.00
sec-Butyl acetate	0.00	0.00	0.00	7.33	0.00	11.78
3,4-dihydro-6-methyl-2,4-pyran	15.65	0.00	6.10	0.00	2.42	4.41
3-Hexanone	0.00	0.00	563.12	632.29	604.21	474.74
Hexanone Isomers	586.25	0.00	0.00	0.00	0.00	0.00
CHO Compounds	0.00	0.00	128.81	13.98	34.71	366.35
CHO Compound	0.00	0.00	0.00	0.00	0.00	20.67
CHO Compound	0.00	0.00	0.00	218.11	0.00	0.00
CHO Compound	0.00	0.00	0.00	404.12	0.00	0.00
5-Methyl-5-Hexen-2-One	0.00	0.00	0.00	156.62	0.00	0.00
Heptanone Isomer	0.00	0.00	22.06	0.00	0.00	0.00
CHO Isomer	0.00	0.00	0.00	544.66	0.00	0.00
Acetate	0.00	0.00	592.31	0.00	0.00	0.00
CHO Compound	810.79	0.00	0.00	0.00	0.00	0.00
Acetate	0.00	251.25	0.00	0.00	97.78	0.00
5-Methylhexen-2-one	0.00	0.00	111.71	0.00	169.24	94.01
Acetate	388.68	0.00	0.00	0.00	0.00	0.00
Acetate	0.00	0.00	0.00	67.98	0.00	0.00
CHO Compound	1036.59	795.89	336.38	49.21	597.74	0.00
CHO Compound	0.00	241.81	0.00	25.12	0.00	0.00
Carboxylic Acid	0.00	0.00	212.99	0.00	354.41	0.00
Acetate	0.00	0.00	0.00	0.00	45.90	47.94
CHO Compound	464.97	0.00	0.00	0.00	0.00	0.00
CHO Compound	0.00	168.05	0.00	0.00	0.00	0.00
Acetate	0.00	0.00	46.41	0.00	0.00	42.25
CHO Compound	273.97	0.00	82.37	0.00	133.58	46.22
CHO Compound	0.00	0.00	0.00	0.00	0.00	36.19
CHO Compound	0.00	28.03	217.81	0.00	347.31	355.19
CHO Compound	0.00	0.00	0.00	0.00	16.11	0.00
Acetate	0.00	0.00	0.00	0.00	8.80	0.00
CHO Compound	0.00	0.00	0.00	30.36	0.00	0.00
Carboxylic acid or ester	90.03	0.00	0.00	0.00	0.00	0.00
Acetate	0.00	0.00	0.00	0.00	30.80	0.00
Acetate	0.00	0.00	0.00	0.00	54.97	0.00
CHO Compound	121.46	0.00	0.00	0.00	0.00	0.00
CHO Compound	66.49	0.00	0.00	42.01	0.00	47.46
Carboxylic Acid	0.00	0.00	109.06	0.00	0.00	0.00
Heptanone Isomer	0.00	0.00	0.00	0.00	68.59	44.88
Acetate	0.00	0.00	0.00	5.11	0.00	0.00
CHO Compound	0.00	0.00	29.84	0.00	0.00	0.00
CHO Cmpd/Naphthalene	0.00	0.00	0.00	0.00	0.00	0.00
Carboxylic Acid	121.18	0.00	0.00	178.03	0.00	139.46
C11H24/CHO Compound	181.27	0.00	0.00	0.00	0.00	0.00
Acetate	0.00	0.00	34.25	0.00	0.00	0.00
CHO Compound	0.00	0.00	0.00	46.97	141.05	0.00
CHO Compound	0.00	0.00	7.29	5.73	0.00	8.46
CHO Compound	0.00	0.00	44.58	25.33	0.00	33.83
CHO Compound	0.00	0.00	0.00	120.83	94.68	63.63
Acetate	0.00	0.00	61.60	53.19	72.54	0.00
Octyl Acetate	210.51	56.83	0.00	0.00	0.00	0.00
Carboxylic Acid or Acetate	0.00	0.00	0.00	0.00	0.00	52.07
Acetate	0.00	0.00	48.96	85.12	170.46	61.50

TABLE B-7 (Continued)

Compound	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6
CHO Compound	0.00	0.00	71.25	0.00	0.00	0.00
CHO Cmpd/Aromatic Cmpd	0.00	0.00	0.00	0.00	0.00	11.81
Acetate	0.00	0.00	44.98	70.43	35.63	0.00
CHO Compound	37.99	25.80	0.00	0.00	157.82	0.00
CHO Compound	47.90	0.00	9.20	14.75	27.21	9.25
Carboxylic Acid	0.00	23.08	0.00	0.00	0.00	0.00
Acetate	0.00	0.00	0.00	24.38	0.00	0.00
CHO Compound	0.00	0.00	0.00	0.00	0.00	21.36
Acetate	223.97	43.93	0.00	13.50	0.00	0.00
CHO Compound	56.82	0.00	8.55	14.84	17.66	11.40
Carboxylic Acid	0.00	0.00	0.00	0.00	20.34	0.00
Decanoic Acid (branched)	0.00	0.00	0.00	0.00	12.89	0.00
Acetate	52.60	0.00	0.00	0.00	0.00	0.00
Carboxylic Acid	0.00	0.00	11.22	0.00	0.00	0.00
CHO Compound	0.00	20.68	0.00	0.00	0.00	0.00
CHO Compound	0.00	0.00	0.00	15.11	26.45	0.00
CHO Compound	91.07	33.70	71.75	61.36	111.52	86.17
CHO Compound	0.00	0.00	0.00	31.93	0.00	0.00
Acetate	0.00	0.00	0.00	0.00	0.00	23.96
Acetate	0.00	0.00	0.00	5.17	14.72	8.10
CHO Compound	0.00	0.00	6.15	0.00	0.00	0.00
CHO Compound	0.00	0.00	0.00	0.00	14.99	0.00
Carboxylic Acid/Unknown	0.00	0.00	0.00	0.00	0.00	5.21
CHO Compound	0.00	9.03	9.44	4.04	23.83	0.00
CHO Compound	0.00	0.00	0.00	0.00	0.00	7.77
Carboxylic Acid or Acetate	0.00	0.00	0.00	0.00	3.78	0.00
CHO Compound	0.00	0.00	7.31	0.00	0.00	0.00
Dodecanoic Acid	83.75	33.66	88.87	69.11	28.78	21.53
CHO Compound	0.00	0.00	0.00	0.00	13.92	0.00
CHO Compound	0.00	0.00	0.00	0.00	4.18	0.00
CHO Compound	11.51	0.00	0.00	0.00	0.00	0.00
CHO Compound	0.00	0.00	0.00	0.00	5.42	0.00
CHO Compound	0.00	0.00	11.12	10.26	0.00	0.00
Carboxylic Acid	8.92	0.00	0.00	0.00	0.00	0.00
CHO Compound	0.00	0.00	0.00	4.51	4.90	0.00
Tetradecanoic Acid	28.36	21.17	34.81	40.53	17.87	17.43
CHO Compound	0.00	0.00	0.00	13.96	0.00	6.07
Pentadecanoic Acid	0.00	0.00	9.69	10.86	14.50	7.42
CHO Compound	6.01	0.00	0.00	0.00	0.00	0.00
Carboxylic Acid	3.20	0.00	0.00	0.00	0.00	0.00
Pentadecatrienoic Acid	0.00	7.48	0.00	15.31	0.00	0.00
Hexadecanoic Acid	38.99	65.32	77.29	72.42	60.77	44.25
Dibutyl Phthalate	9.55	0.00	0.00	0.00	0.00	0.00
Heptadecanoic Acid	0.00	0.00	2.47	0.00	0.00	0.00
CHO Compound	0.00	0.00	5.16	0.00	0.00	0.00
CHO Compound	0.00	0.00	4.47	0.00	0.00	0.00
Heptadecatrienoic Acid	9.03	13.85	12.80	19.12	11.06	10.32
Nonadecanoic Acid	0.00	0.00	0.00	8.53	0.00	0.00
Carboxylic Acid	0.00	8.03	0.00	0.00	0.00	0.00
Tributylcitrate	0.00	0.00	0.00	3.10	0.00	0.00
CHO Compound	51.63	30.84	37.34	26.24	44.26	34.35
Butyl Octadecanoate	2.41	5.31	0.00	6.40	0.00	0.00
CHO Compound	0.00	0.00	0.00	0.00	0.00	4.97
totals	5131.54	1883.74	3179.53	3329.77	3717.81	2282.41

TABLE B-7 (Continued)

Aliphatic Hydrocarbons (ug/m3)

Compound	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6
Hydrocarbon	0.00	0.00	0.00	0.00	0.00	6.51
Hydrocarbon	0.00	0.00	0.00	0.00	261.22	0.00
C11H24/CHO Compound	181.27	0.00	0.00	0.00	0.00	0.00
Hydrocarbon	0.00	0.00	0.00	0.00	0.00	56.63
Hydrocarbon	0.00	56.28	0.00	0.00	0.00	0.00
C14H30	0.00	0.00	0.00	0.00	30.35	0.00
Hydrocarbon	0.00	8.68	0.00	0.00	0.00	0.00
C14H30	23.72	10.71	28.16	9.04	30.15	20.17
C14H28	0.00	0.00	0.00	0.00	11.61	0.00
Hydrocarbon	0.00	0.00	0.00	0.00	24.43	0.00
C15H32	0.00	0.00	19.35	0.00	0.00	0.00
Hydrocarbon	0.00	0.00	6.98	0.00	0.00	0.00
Hydrocarbon	0.00	0.00	0.00	0.00	4.32	2.97
C16H34	7.52	0.00	0.00	0.00	0.00	0.00
Hydrocarbon	9.55	0.00	0.00	0.00	6.43	0.00
Hydrocarbon	8.94	0.00	0.00	8.17	0.00	6.57
Hydrocarbon	8.77	0.00	0.00	0.00	0.00	0.00
Hydrocarbon	6.99	0.00	0.00	0.00	0.00	0.00
Hydrocarbon	5.25	0.00	0.00	0.00	0.00	0.00
Hydrocarbon/unknown	0.00	0.00	16.74	0.00	0.00	0.00
totals	252.02	75.68	71.22	17.21	368.50	92.84

TABLE B-7 (Continued)

Aromatic Hydrocarbons (ug/m3)

Compound	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6
Methyl Benzoate	90.03	0.00	29.51	0.00	0.00	23.14
Aromatic Compound	0.00	12.20	20.40	0.00	0.00	24.38
Oxyg. Aromatic Cmpd.	0.00	0.00	0.00	34.11	0.00	0.00
CHO Cmpd./Aromatic Cmpd.	0.00	0.00	0.00	0.00	0.00	11.81
Diethyl Phthalate	40.66	10.00	33.32	364.07	23.80	24.62
Phthalate	4.57	0.00	0.00	0.00	0.00	0.00
Amide/Phthalate	0.00	0.00	0.00	0.00	0.00	3.97
Phthalate	0.00	0.00	0.00	6.35	0.00	11.59
Phthalate	0.00	0.00	0.00	0.00	0.00	2.92
totals	135.27	22.20	83.23	404.54	23.80	102.43

TABLE B-7 (Continued)

Halogenated Compounds (ug/m3)

Compound	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6
1,1,1-trich.-2-ME-2-prpnol	0.00	95.87	46.09	0.00	0.00	101.46
Chlorocyclohexanol	0.00	0.00	0.00	57.69	0.00	0.00
Chlorocyclohexanol	176.10	135.72	0.00	0.00	104.97	24.87
CHOCl Cmpd	0.00	0.00	0.00	333.97	0.00	0.00
CHOCl Cmpd	373.30	334.37	0.00	0.00	0.00	0.00
Chlorocyclohexanol	0.00	0.00	164.91	0.00	0.00	0.00
Dichloropentane	0.00	0.00	0.00	0.00	0.00	53.44
totals	549.41	565.97	211.00	391.66	104.97	179.77

TABLE B-7 (Continued)

Nitrogenated Compounds (ug/m3)

Compound	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6
Hexadecanamide	0.00	0.00	0.00	0.00	0.00	8.22
Octadecanamide	0.00	0.00	0.00	0.00	0.00	3.64
Amide/Phthalate	0.00	0.00	0.00	0.00	0.00	3.97
totals	0.00	0.00	0.00	0.00	0.00	15.82

TABLE B-7 (Continued)

Unknown Constituents (ug/m3)

Compound	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6
Unknown	0.00	0.00	0.00	0.00	5.69	0.00
Unknown	0.00	0.00	11.31	0.00	45.22	10.75
Unknown	0.00	0.00	0.00	27.74	0.00	0.00
Methyl Benzoate/Unknown	0.00	0.00	29.51	0.00	0.00	0.00
Unknown	0.00	85.84	21.43	0.00	0.00	0.00
Unknown	0.00	75.15	0.00	22.79	0.00	0.00
Unknown	0.00	0.00	0.00	75.16	0.00	21.41
Unknown	37.77	18.41	27.71	0.00	0.00	0.00
Unknown	0.00	54.01	0.00	0.00	0.00	0.00
Unknown	0.00	119.56	0.00	0.00	5.51	0.00
Unknown	370.47	106.86	0.00	0.00	59.58	0.00
C14H30/Unknown	0.00	0.00	19.75	0.00	0.00	0.00
Unknown	0.00	33.07	0.00	11.01	0.00	28.64
Unknown	10.84	10.36	22.77	11.79	0.00	26.72
Unknown	0.00	0.00	9.06	0.00	17.55	0.00
Unknown	19.63	0.00	17.49	0.00	34.30	0.00
Unknown	0.00	0.00	13.12	0.00	0.00	4.91
Unknown	0.00	0.00	3.99	0.00	6.66	0.00
Carboxylic Acid/Unknown	0.00	0.00	0.00	0.00	0.00	5.21
Unknown	20.16	0.00	0.00	7.82	10.75	14.86
Unknown/Unknown	0.00	0.00	7.37	0.00	0.00	0.00
Unknown	0.00	0.00	7.43	0.00	7.27	5.25
Unknown	0.00	0.00	0.00	0.00	15.91	0.00
Unknown	4.18	0.00	0.00	0.00	14.90	5.27
Unknown	0.00	0.00	0.00	0.00	8.50	0.00
Unknown	0.00	0.00	0.00	0.00	0.00	13.80
Unknown	35.52	0.00	0.00	0.00	0.00	0.00
Unknown	0.00	15.44	0.00	0.00	0.00	0.00
Unknown	14.31	0.00	0.00	0.00	8.76	13.18
Unknown	9.30	6.69	0.00	0.00	0.00	0.00
Unknown	15.86	19.37	0.00	0.00	0.00	0.00
Unknown	0.00	0.00	0.00	0.00	0.00	8.10
Unknown	0.00	0.00	0.00	0.00	12.67	0.00
Unknown	0.00	0.00	4.75	0.00	6.29	0.00
Unknown	5.37	0.00	0.00	0.00	6.96	5.33
Unknown	0.00	0.00	0.00	5.42	0.00	0.00
Unknown	0.00	0.00	0.00	5.74	0.00	0.00
Unknown	0.00	0.00	0.00	0.00	5.18	0.00
Unknown	5.08	0.00	0.00	0.00	0.00	0.00
Hydrocarbon/Unknown	0.00	0.00	16.74	0.00	0.00	0.00
totals	548.50	544.76	212.43	167.47	271.70	163.42

TABLE B-8. CORRECTED STACK CONCENTRATIONS OF SEMIVOLATILE CONSTITUENTS

Oxygenated Aliphatic Hydrocarbons (ug/m3)

Compound	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6
sec-Butyl acetate	0.00	0.00	0.00	7.33	0.00	11.78
3,4-dihydro-6-methyl-2,4-pyran	15.65	0.00	6.10	0.00	2.42	4.41
CHO Compounds	0.00	0.00	128.81	13.98	34.71	366.35
Acetate	388.68	251.25	592.31	67.98	0.00	0.00
5-Methylhexen-2-one	0.00	0.00	111.71	0.00	169.24	94.01
CHO Compound	0.00	241.81	0.00	25.12	0.00	0.00
Carboxylic Acid	0.00	0.00	212.99	0.00	354.41	0.00
Acetate	0.00	0.00	0.00	0.00	45.90	47.94
CHO Compound	464.97	168.05	0.00	0.00	0.00	0.00
Acetate	0.00	0.00	46.41	0.00	0.00	42.25
CHO Compound	273.97	0.00	82.37	0.00	133.58	46.22
CHO Compound	0.00	28.03	217.81	0.00	347.31	355.19
CHO Compound	66.49	0.00	0.00	42.01	0.00	47.46
Heptanone Isomer	0.00	0.00	0.00	0.00	68.59	44.88
Carboxylic Acid	121.18	0.00	0.00	178.03	0.00	139.46
CHO Compound	0.00	0.00	0.00	46.97	141.05	0.00
CHO Compound	0.00	0.00	7.29	5.73	0.00	8.46
CHO Compound	0.00	0.00	44.58	25.33	0.00	33.83
CHO Compound	0.00	0.00	0.00	120.83	94.68	63.63
Acetate	0.00	0.00	61.60	53.19	72.54	0.00
Octyl Acetate	210.51	56.83	0.00	0.00	0.00	0.00
Acetate	0.00	0.00	48.96	85.12	170.46	61.50
Acetate	0.00	0.00	44.98	70.43	35.63	0.00
CHO Compound	37.99	25.80	0.00	0.00	157.82	45.00
CHO Compound	47.90	0.00	9.20	14.75	27.21	9.25
Acetate	223.97	43.93	0.00	13.50	0.00	0.00
CHO Compound	56.82	0.00	8.55	14.84	17.66	11.40
CHO Compound	0.00	0.00	0.00	15.11	26.45	0.00
CHO Compound	91.07	33.70	71.75	61.36	111.52	86.17
Acetate	0.00	0.00	0.00	5.17	14.72	8.10
CHO Compound	0.00	9.03	9.44	4.04	23.83	0.00
Dodecanoic Acid Isomer	12.81	0.00	2.23	0.00	0.00	0.00
Dodecanoic Acid	83.75	33.66	88.87	69.11	28.78	21.53
CHO Compound	0.00	0.00	11.12	10.26	0.00	0.00
CHO Compound	0.00	0.00	0.00	4.51	4.90	0.00
Tetradecanoic Acid	28.36	21.17	34.81	40.53	17.87	17.43
CHO Compound	0.00	0.00	0.00	13.96	0.00	6.07
Pentadecanoic Acid	0.00	0.00	9.69	10.86	14.50	7.42
Pentadecatrienoic Acid	0.00	7.48	0.00	15.31	0.00	0.00
Hexadecanoic Acid	38.99	65.32	77.29	72.42	60.77	44.25
Heptadecatrienoic Acid	9.03	13.85	12.80	19.12	11.06	10.32
CHO Compound	51.63	30.84	37.34	26.24	44.26	34.35
Butyl Octadecanoate	2.41	5.31	0.00	6.40	0.00	0.00
totals	2226.18	1036.07	1979.00	1159.52	2231.87	1668.66

TABLE B-8 (Continued)

Aliphatic Hydrocarbons (ug/m3)

Compound	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6
C14H30	23.72	10.71	28.16	9.04	30.15	20.17
Hydrocarbon	0.00	0.00	0.00	0.00	4.32	2.97
Hydrocarbon	9.55	0.00	0.00	0.00	6.43	0.00
Hydrocarbon	8.94	0.00	0.00	8.17	0.00	6.57
totals	42.21	10.71	28.16	17.21	40.90	29.70

TABLE B-8 (Continued)

Aromatic Hydrocarbons (ug/m3)

Compound	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6
Methyl Benzoate	0.00	0.00	29.51	0.00	0.00	23.14
Aromatic Compound	0.00	12.20	20.40	0.00	0.00	24.38
Diethyl Phthalate	0.00	38.22	33.32	364.07	23.80	24.62
4,4-Furo[3,2-6]Benzopyran-4,1,9-Trione?	32.36	36.90	40.48	37.39	39.62	32.42
Phthalate	0.00	0.00	0.00	6.35	0.00	11.59
totals	32.36	87.32	123.71	407.81	63.42	116.16

TABLE B-8 (Continued)

Halogenated Hydrocarbons (ug/m3)

Compound	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6
1,1,1-trich.-2-ME-2-prpnol	0.00	95.87	46.09	0.00	0.00	101.46
Chlorocyclohexanol	176.10	135.72	164.91	57.69	104.97	24.87
CHOCl Cmpd	373.30	334.37	0.00	333.97	0.00	0.00
totals	549.41	565.97	211.00	391.66	104.97	126.33

TABLE B-8 (Continued)

Unknown Constituents (ug/m3)

Compound	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6
Unknown	0.00	0.00	11.31	0.00	45.22	10.75
Unknown	0.00	85.84	21.43	0.00	0.00	0.00
Unknown	0.00	75.15	0.00	22.79	0.00	0.00
Unknown	0.00	0.00	0.00	75.16	0.00	21.41
Unknown	37.77	18.41	27.71	0.00	0.00	0.00
Unknown	0.00	119.56	0.00	0.00	5.51	0.00
Unknown	370.47	106.86	0.00	0.00	59.58	0.00
Unknown	0.00	33.07	0.00	11.01	0.00	28.64
Unknown	10.84	10.36	22.77	11.79	0.00	26.72
Unknown	0.00	0.00	9.06	0.00	17.55	0.00
Unknown	19.63	0.00	17.49	0.00	34.30	0.00
Unknown	0.00	0.00	13.12	0.00	0.00	4.91
Unknown	0.00	0.00	3.99	0.00	6.66	5.21
Unknown	20.16	0.00	7.37	7.82	10.75	14.86
Unknown	0.00	0.00	7.43	0.00	7.27	5.25
Unknown	4.18	0.00	0.00	0.00	14.90	5.27
Unknown	14.31	15.44	0.00	0.00	8.76	13.18
Unknown	9.30	6.69	0.00	0.00	0.00	0.00
Unknown	15.86	19.37	0.00	0.00	0.00	0.00
Unknown	0.00	0.00	4.75	0.00	6.29	0.00
Unknown	5.37	0.00	0.00	0.00	6.96	5.33
totals	507.90	490.74	146.42	128.57	223.76	141.52

ALDEHYDE DATA

Data for aldehydes consist of concentrations (ng/mL of sample volume). Multiplication by volume (mL) of sample collected yields the total mass in the sample. Division by sample gas volume (corrected to standard conditions) gives final results shown in Table B-9 in micrograms per liter of stack gas sampled.

Sample volumes from Runs 4 and 5 were too large for a single impinger recovery, requiring samples 4-1, 4-2 and 5-1, 5-2 to be analyzed separately. For these samples, determination of aldehyde stack concentration involves multiplying the concentration of each sample by its appropriate sample volume, summing the two values for the run and dividing by the total gas volume.

TABLE B-9. ALDEHYDE DATA

	Concentration (ng/mL)									
Compound	Run 1	Run 2	Run 3	Run 4-1*	Run 4-2	Run 5-1*	Run 5-2	Run 6	Reagent Blank 1	Reagent Blank 5
Unknown	0	0	49.4	34.17	79.32	47.47	63.5	48.78	85.7	77.79
Unknown	0	0	0.51	0	0	0	0	0		0
Unknown	0.14	0.08	0	0	0.1	0	0.12	0	0.5	0.08
Unknown	0	0	0.06	0	0.13	0	0	0	0.42	0
Unknown	0	0	0	0	0	0.87	0	0		
Unknown	0.37	0.48	0.51	3.41	0	0	0	0		0
Unknown	0.2	0	0	0	0	0.28	0	0.1	1.35	0.12
Unknown	0.66	0	0	0	0	1.15	0	0.67		0
Unknown	0	0.39	0.35	1.11	0.43	0	0.46	0		0
Unknown	0.96	1.89	1.08	1.05	0.67	0.83	0.3	0.85	1.56	0.46
Unknown	0	0	0.75	1.03	0	0	0	0		0
Unknown	131.36	94.22	90.69	78.73	200.72	75.81	108.71	116.12	293.67	113.88
Unknown	0	12.96	13.07	19.76	8.5	2.37	8.82	2.6		0
Unknown	1.19	0	0	0	0	0	0	0	0.88	1.54
Unknown	0	0	0	0	0	0	2.07	0		1.85
Unknown	5.43	0	0	0	0	1.21	0	3.45		0
Unknown	4.06	7.02	7.47	11.45	7.02	7.5	7.27	5.93	1.53	0.82
Unknown	0	0	0	0	0	0	0	0	0.45	0.24
Unknown	0	0.71	0.94	1.06	0.74	0.46	0.84	0.56		0
Formaldehyde	10.8	42.31	49.54	31.35	36.09	10.25	24.63	15.24	16.84	2.04
Unknown	0	0.33	0.48	0.49	0.32	0.17	0.24	0.1		0
Unknown	0.06	0.25	0.66	0	0.91	0	0.47	0	0.4	0.35
Unknown	0	0	0	0	0	0.43	0	0.58		
Unknown	2.89	7.31	11.78	13	12.75	4.15	6.19	4.95	0.54	0.28
Unknown	0.51	1.17	1.54	0.41	3.44	0.19	0.58	0.59	6.09	0.68
Unknown	0	0	0	0	0	0	0	0	0.09	0
Unknown	0	0.08	0.12	0	0	1.28	0	0		0
Sample Vol. (ml)	51.4	64	59.4	62.8	20.7	58.8	25.8	51.6		
STP Gas Vol. (L)	27.969	25.482	26.283	30.354		30.261		20.626		

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* Run 4 and 5 samples split due to excessive volume collected in impinger.

FIELD GAS CHROMATOGRAPHY DATA

Data from the two gas chromatographs (PID and Hall) are shown in Tables B-10 and B-11. Several injections were performed on each instrument during a run, resulting in raw data concentrations in ng/L (Subtable I - Concentrations by Individual Injection).

For Runs 1 through 3, values reported in Subtable II are averages of all injections for the run. For Runs 4 through 6, reported values are averages of all injections, excluding the peak values observed during a transient upset spike.

Values for Subtable III (emissions in ppb) are obtained through dividing the average concentrations in Subtable II by a factor based upon the compounds' molecular weight.

Values for Subtable IV (emissions in ppb methane) are obtained through multiplication of Subtable III (emissions in ppb) by a factor based upon the compounds' carbon number.

TABLE B-10. GC-PID RESULTS

I. Concentrations by Individual Injections (ng/L)

Compound	1A	1B	1C	1D	2A	2C	3A	3B	3C	3D	3E	4A	4B	5A	5B	5C	6A	6B	6C
Vinyl chloride	0.5	2.9	11.3	5.3	14.3	0.0	34.9	17.9	14.7	4.8	13.1	3.4	3.7	15.4	16.1	5.7	10.2	7.9	6.5
Acetaldehyde	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	41.3
Acetone	0.0	0.0	0.0	0.0	16.5	0.0	0.0	35.8	35.8	0.0	41.3	0.0	35.8	27.5	27.5	33.0	0.0	13.8	24.8
Unknown	63.5	48.2	0.0	63.5	114.2	101.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Benzene	15.0	0.0	0.0	23.6	11.7	29.3	13.1	17.5	17.5	0.0	0.0	10.9	49.9	7.2	7.2	837.0	0.0	272.3	7,317.7
Trichloroethylene	0.0	0.0	0.0	0.0	0.0	25.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Unknown	0.0	0.0	0.0	0.0	0.0	0.0	76.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Unknown	0.0	0.0	0.0	0.0	146.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	38.1	0.0	25.4	0.0
Toluene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	78.3	0.0	0.0	105.0
Chlorobenzene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.8	0.0	0.0	0.0
Ethylbenzene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	28.9	0.0	0.0	0.0

II. Average Concentrations by Run (ng/L)

Compound	1	2	3	4	5	6
Vinyl chloride	5.0	7.2	17.1	3.4	10.5	7.2
Acetaldehyde	0.0	0.0	0.0	0.0	0.0	0.0
Acetone	0.0	8.3	22.6	0.0	27.5	6.9
Unknown	43.8	107.9	0.0	0.0	0.0	0.0
Benzene	9.6	20.5	9.6	10.9	7.2	136.2
Trichloroethylene	0.0	12.7	0.0	0.0	0.0	0.0
Unknown	0.0	0.0	15.2	0.0	0.0	0.0
Unknown	0.0	73.0	0.0	0.0	0.0	0.0
Toluene	0.0	0.0	0.0	0.0	0.0	0.0
Chlorobenzene	0.0	0.0	0.0	0.0	0.0	0.0
Ethylbenzene	0.0	0.0	0.0	0.0	0.0	0.0

III. Average Emissions by Run (ppb)

Compound	Factor (div.)	1	2	3	4	5	6
Vinyl chloride	2.6	1.9	2.8	6.6	1.3	4.1	2.8
Acetaldehyde	1.8	0.0	0.0	0.0	0.0	0.0	0.0
Acetone	2.4	0.0	3.4	9.4	0.0	11.5	2.9
Benzene	3.2	3.0	6.4	3.0	3.4	2.2	42.6
Trichloroethylene	5.5	0.0	2.3	0.0	0.0	0.0	0.0
Toluene	3.8	0.0	0.0	0.0	0.0	0.0	0.0
Chlorobenzene	4.7	0.0	0.0	0.0	0.0	0.0	0.0
Ethylbenzene	4.4	0.0	0.0	0.0	0.0	0.0	0.0

IV. Average Emissions by Run (ppb Methane)

Compound	Factor (mult.)	1	2	3	4	5	6
Vinyl chloride	1.75	3.4	4.8	11.5	2.5	7.1	4.8
Acetaldehyde	1.00	0.0	0.0	0.0	0.0	0.0	0.0
Acetone	2.00	0.0	6.9	18.8	29.8	22.9	5.7
Benzene	6.00	18.1	38.4	18.0	93.6	13.5	255.3
Trichloroethylene	1.50	0.0	3.5	0.0	0.0	0.0	0.0
Toluene	7.00	0.0	0.0	0.0	0.0	0.0	0.0
Chlorobenzene	6.00	0.0	0.0	0.0	0.0	0.0	0.0
Ethylbenzene	8.00	0.0	0.0	0.0	0.0	0.0	0.0

TABLE B-11. GC-HALL RESULTS

I. Concentrations by Individual Injections (ng/L)

Compound	1A	1B	1C	1D	2A	2B	2C	3A	3B	3C	3D	4A	4B	5A	5B	5C	6A	6B	6C
Methyl chloride	1,898.5	0	0	0	1,184.2	351.3	417.1	249.3	242.9	205.6	165.8	962.7	422.8	455.0	363.1	1,028.7	712.8	601.3	785.0
Methyl bromide	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	318.3	0	0
Dichloromethane	46.4	19.3	0	0	0	0	0	14.9	0	0	2.3	51.5	0	135.1	117.5	279.9	101.3	195.7	0
Chlorobromomethane	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14.7	0	0
Unknown	0	2.9	0	1.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chloroform	95.5	86.4	59.8	65.8	104.7	215.5	240.2	189.0	177.3	194.6	160.4	162.3	0	24.9	31.8	50.6	0	62.3	0
1,1,1-Trichloroethane	0	0	0	0	0	0	9.5	0	0	0	0	0	0	0	0	0	0	0	0
Carbon tetrachloride	0	0	0	6.9	0	4.7	0	9.7	0.3	6.1	8.3	8.3	179.3	9.3	12.2	6.6	0	15.8	0
Dichlorobromomethane	35.0	36.7	24.0	24.0	42.5	58.3	65.8	46.1	50.4	51.9	14.3	37.8	811.4	0	0	0	0	0	0
1,2-Dichloropropane	0	0	0	0	0	0.3	0	0	0	1.6	0	0	3.1	0	0	0	0	0	0

II. Average Concentrations by Run (ng/L)

Compound	1	2	3	4	5	6
Methyl chloride	474.6	650.9	215.9	422.8	409.1	657.0
Methyl bromide	0	0	0	0	0	0
Dichloromethane	16.4	3.7	4.3	0	177.5	50.7
Chlorobromomethane	0	0	0	0	0	0
Unknown	1.2	0	0	0	0	0
Chloroform	76.9	187.4	180.3	0	28.3	0
1,1,1-Trichloroethane	0	2.4	0	0	0	0
Carbon tetrachloride	1.7	3.6	6.1	8.3	7.9	0
Dichlorobromomethane	29.9	53.2	40.7	37.8	0	0
1,2-Dichloropropane	0	0.1	0.4	0	0	0

III. Average Emissions by Run (ppb)

Compound	Factor (div.)	1	2	3	4	5	6
Methyl chloride	2.1	226.0	309.9	102.8	201.3	194.8	312.9
Methyl bromide	3.9	0.0	0.0	0.0	0.0	0.0	0.0
Dichloromethane	3.5	4.7	1.1	1.2	0.0	50.7	14.5
Chlorobromomethane	5.4	0.0	0.0	0.0	0.0	0.0	0.0
Chloroform	5.0	15.4	37.5	36.1	0.0	5.7	0.0
1,1,1-Trichloroethane	5.5	0.0	0.4	0.0	0.0	0.0	0.0
Carbon tetrachloride	6.4	0.3	0.6	1.0	1.3	1.2	0.0
Dichlorobromomethane	6.8	4.4	7.8	6.0	5.6	0.0	0.0
1,2-Dichloropropane	4.7	0.0	0.0	0.1	0.0	0.0	0.0

IV. Average Emissions by Run (ppb Methane)

Compound	Factor (mult.)	1	2	3	4	5	6
Methyl chloride	0.95	214.7	294.4	97.7	191.3	185.1	297.2
Methyl bromide	0.95	0.0	0.0	0.0	0.0	0.0	0.0
Dichloromethane	0.90	4.2	1.0	1.1	0.0	45.6	13.0
Chlorobromomethane	0.90	0.0	0.0	0.0	0.0	0.0	0.0
Chloroform	0.85	13.1	31.9	30.7	0.0	4.8	0.0
1,1,1-Trichloroethane	1.50	0.0	0.6	0.0	0.0	0.0	0.0
Carbon tetrachloride	0.64	0.2	0.4	0.6	0.8	0.8	0.0
Dichlorobromomethane	0.85	3.7	6.6	5.1	4.7	0.0	0.0
1,2-Dichloropropane	2.90	0.0	0.0	0.3	0.0	0.0	0.0

WASTE ANALYSIS DATA

TABLE B-12. WASTE FEED CHARACTERISTICS

	Run No.[a]						
	1	2	3-A	3-B	4	5	6
SOLIDS							
Chlorinated pyridine							
% Total organic chlorine	50.10	11.65	17.48	17.14	11.09	21.21	29.95
% Ash	7.47	45.82	52.11	55.50	41.41	42.66	28.69
HHV (BTU/lb)	3,394	1,657	847	912	877	2,021	2,205
Feedrate (lb/hr)	1,218	1,412	1,270	NA	1,348	1,448	1,260
Polyethylene wax							
% Total organic chlorine	0.0086	< 0.01	0.030	0.029	0.014	0.010	0.0057
% Ash	0.10	0.062	0.34	0.33	0.042	0.10	0.12
HHV (BTU/lb)	17,354	12,424	15,929	15,973	15,473	17,409	18,410
Feedrate (lb/hr)	508	524	506	NA	375	496	547
Substituted cellulose							
% Total organic chlorine	0.24	0.69	0.23	0.20	0.23	0.39	1.21
% Ash	7.90	3.32	1.01	1.03	1.90	1.89	5.07
HHV (BTU/lb)	7,055	8,245	5,648	5,998	9,084	1,818	7,849
Feedrate (lb/hr)	991	1,121	1,232	NA	919	1,658	1,112
LIQUIDS							
Liquid organic							
% Total organic chlorine	10.03	11.37	10.33	10.97	10.59	11.60	10.21
% Ash	0.029	0.044	0.047	0.027	0.037	0.038	0.0043
HHV (BTU/lb)	18,178	17,962	17,989	17,934	17,959	18,023	17,966
Saybolt viscosity (sec)	40.0	37.0	41.2	41.6	39.1	38.6	39.9
Feedrate (lb/hr)[b]	493/821	616/821	452/821	NA	452/821	534/821	493/821
Liquid aqueous							
% Total organic chlorine	0.0049	0.0052	0.0031	0.0033	0.0049	< 0.0010	< 0.0010
% Ash	0.038	0.034	0.027	0.017	0.023	0.032	0.047
HHV (BTU/lb)	16	NF	42	18	NF	NF	NF
Feedrate (lb/hr)	5,007	5,007	5,007	NA	5,007	4,807	5,007

[a] Runs 3-A and 3-B are replicate analysis.

[b] To kiln/to SCC.

NF - none found.

NA - not applicable.

TABLE B-13. PRIORITY POLLUTANT CONCENTRATION IN LIQUID ORGANIC WASTE FEED

Compound	Concentration (ppm)[a]					
	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6
Benzene	224	ND[b]	275	323	270	217
Carbon tetrachloride[c]	10.4%	10.4%	10.3%	10.2%	10.1%	10.1%
Chlorobenzene	ND	ND	239	267	366	402
Chloroform	166	ND	505	2,600	155	1,480
Ethylbenzene	236	ND	ND	ND	ND	557
Methylene chloride	1,580	ND	1,560	243	144	366
Tetrachloroethene	528	ND	ND	ND	ND	ND
Toluene	351	ND	82	214	232	185

[a] Based on MRI analyses.

[b] ND = Not detected.

[c] Carbon tetrachloride concentrations from Dow analysis, expressed in (%) concentration.

TABLE B-14. PRIORITY POLLUTANT CONCENTRATION IN AQUEOUS WASTE FEED

Priority pollutant	Concentration (ppm)[a]											
	Run 1		Run 2		Run 3		Run 4		Run 5		Run 6	
	MRI	DOW	MRI	DOW	MRI	DOW	MRI	DOW	MRI	DOW	MRI	DOW
Benzene	4.9	5.8	1.7	ND	1.2	ND	4.4	4.0	2.4	2.1	0.5	1.4
Carbon tetrachloride	12.4	14.3	11.0	16.1	9.0	12.7	10.6	8.6	7.3	7.2	ND	5.7
2-Chloroethylvinyl ether	6.8	ND	6.1	ND	4.8	ND	4.7	ND	3.8	ND	ND	ND
Chloroform	4.3	3.5	1.9	2.6	1.4	1.8	1.9	1.3	1.1	0.6	2.1	BDL
1,1-Dichloroethane	0.6	0.7	ND	0.5	ND	BDL	ND	BDL	ND	BDL	ND	BDL
1,1-Dichloroethene	0.8	0.6	ND	ND	ND	ND	0.4	BDL	ND	BDL	ND	BDL
1,2-Dichloropropane	1.3	1.2	ND	0.6	ND	0.4	ND	0.6	ND	0.5	ND	BDL
trans-1,3-Dichloropropene	ND	ND	ND	ND	ND	ND	0.3	ND	0.7	ND	ND	ND
Ethylbenzene	0.9	BDL	0.1	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methylene chloride	33.0	22.6	9.5	10.3	6.3	6.0	11.4	9.7	6.0	5.5	1.3	3.8
1,1,2,2-Tetrachloroethane	0.6	BDL	ND	BDL	ND	BDL	0.1	BDL	0.1	ND	ND	ND
Tetrachioroethylene	4.4	4.2	2.0	4.4	1.7	3.5	2.2	5.5	1.5	6.4	0.5	14.8
Toluene	4.5	6.1	4.0	0.5	3.3	ND	4.0	3.2	2.9	2.0	1.0	1.5
1,1,1-Trichloroethane	22.4	25.5	11.0	18.4	8.0	13.2	15.8	13.9	9.0	9.5	4.6	6.5
1,1,2-Trichloroethane	8.2	7.5	4.2	6.0	3.0	4.4	4.4	4.2	2.5	2.4	1.7	ND
Trichloroethylene	0.2	BDL	ND	1.1	ND	0.9	ND	BDL	ND	BDL	ND	1.6

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[a] Limit of quantitation = 0.4 ppm (DOW).

BDL = Below detection limit.

ND = Not detected.

METALS ANALYSIS DATA

Table B-15 contains the sample number matrix for the various waste feeds analyzed. The metals analytical data is contained in attached Tables B-16 through B-18. Table B-16 contains the sample, duplicate (Dup), high spike (Spk H), and low spike (Spk L) final analyte concentrations in units of micrograms analyte per gram sample. The column headings indicate the analyte determined and the corresponding wavelength (nm) used. The results in this table are instrumentally corrected for a scandium internal standard addition. Table B-17 contains range percent data as an estimate of precision on duplicate determinations. Table B-18 contains percent recoveries determined from the spike determinations.

TABLE B-15. METALS ANALYSIS MATRIX

	Run No. 1					Run No. 6				
	Sample No.									
Waste feed type	1001	1005	1007	1009	1011	6001	6005	6007	6009	6011
Chlorinated pyridine				X					X	
Polyethylene wax			X					X		
Substituted cellulose		X					X			
Liquid organic	X					X				
Liquid aqueous					X					X

TABLE B-16. WEIGHT DILUTION CORRECTED CONCENTRATION

Weight Dilution Corrected Concentrations (mcg/g)

Sample ID	Cr205.552 (mcg/g)	Cu324.754 (mcg/g)	Zn213.856 (mcg/g)	Hg184.949 (mcg/g)	Be313.042 (mcg/g)	Ag328.068 (mcg/g)	Tl190.864 (mcg/g)	As193.759 (mcg/g)	Ba455.403 (mcg/g)
1001	1.720	17.300	32.740	<5.771	0.125	5.655	<9.387	<12.447	1.253
Dup 1001	2.297	19.520	32.810	<6.948	0.158	4.815	17.210	<14.985	1.438
Spk L 1001	40.930	54.440	72.140	38.780	37.310	36.110	49.320	30.260	36.950
Spk H 1001	57.070	68.730	86.930	307.900	53.370	321.000	61.010	312.100	309.400
6001	2.375	16.100	28.470	<5.008	0.082	3.039	17.090	<10.800	1.052
1005	4.998	23.960	79.210	<8.157	0.151	5.011	17.260	<17.592	5.295
Dup 1005	4.586	22.000	84.240	<7.212	0.123	3.889	<11.731	<15.554	5.040
Spk L 1005	51.380	65.800	146.800	40.570	44.670	46.940	41.150	42.360	47.040
Spk H 1005	86.260	99.570	171.000	462.700	80.420	436.800	77.100	492.300	459.500
6005	4.110	15.100	9.636	<7.698	0.176	4.260	14.040	<16.602	1.412
1007	2.478	46.260	65.440	<6.660	<0.080	7.081	13.000	<14.363	2.270
Dup 1007	2.504	22.440	61.470	<6.315	<0.076	3.949	13.860	<13.620	2.060
Spk L 1007	36.810	52.060	92.090	31.300	33.460	33.250	37.000	29.010	33.190
Spk H 1007	63.320	75.830	112.800	372.800	58.950	371.000	65.370	379.300	372.500
6007	1.357	16.590	30.620	<4.135	0.070	2.306	8.256	<8.917	1.157
1009	14.530	19.030	24.000	<4.724	0.090	2.337	9.975	<10.188	26.720
Dup 1009	17.860	18.940	26.520	<3.908	0.105	2.049	9.043	<8.428	61.670
Spk L 1009	52.140	54.060	64.000	34.270	33.780	36.120	32.780	33.090	71.670
Spk H 1009	69.910	68.350	78.950	303.400	49.370	337.900	56.230	309.500	315.700
6009	903.200	39.420	74.490	<5.873	0.245	2.777	23.350	<12.666	59.660
1011	0.330	0.601	3.698	<0.086	0.002	0.088	0.235	<0.186	0.193
Dup 1011	0.317	0.597	3.307	<0.086	0.002	0.064	0.283	<0.186	0.190
Spk L 1011	0.868	1.096	4.038	0.520	0.537	0.558	0.446	0.487	0.679
Spk H 1011	6.131	5.833	9.341	5.727	5.829	3.976	5.274	5.873	5.424
6011	0.025	0.161	0.732	<0.081	0.003	0.047	0.271	<0.175	0.494

Note: mcg/g = microgram/gram.

TABLE B-16 (Continued)

Weight Dilution Corrected Concentrations (mcg/g)

Sample ID	Se196.090 (mcg/g)	Sb206.833 (mcg/g)	Ni231.604 (mcg/g)	Cd214.438 (mcg/g)	Pb220.353 (mcg/g)
1001	<17.383	<7.649	<3.685	1.478	<9.943
Dup 1001	<20.929	<9.209	<4.437	2.269	<11.971
Spk L 1001	46.710	40.970	36.370	39.100	38.710
Spk H 1001	52.110	318.200	317.300	55.820	57.580
6001	<15.083	<6.637	<3.198	1.771	<8.628
1005	<24.569	<10.811	<5.209	4.026	<14.054
Dup 1005	22.120	<9.558	<4.605	3.846	<12.426
Spk L 1005	43.100	47.800	47.540	50.230	56.140
Spk H 1005	95.800	467.000	476.400	84.350	91.990
6005	<23.188	<10.203	<4.916	2.255	<13.263
1007	<20.060	<8.826	<4.253	1.816	<11.474
Dup 1007	<19.022	<8.370	<4.033	1.898	<10.881
Spk L 1007	36.640	37.970	32.360	35.630	36.020
Spk H 1007	60.140	392.200	381.600	61.130	64.140
6007	<12.453	<5.480	<2.640	1.508	<7.123
1009	<14.229	<6.261	40.300	1.860	<8.139
Dup 1009	<11.771	<5.179	46.640	1.931	<6.733
Spk L 1009	42.210	23.440	77.570	36.260	34.290
Spk H 1009	50.650	222.500	351.400	52.400	53.140
6009	<17.691	<7.784	1247.000	5.403	12.110
1011	<0.260	0.116	0.345	0.035	<0.149
Dup 1011	<0.260	<0.114	0.349	0.034	<0.149
Spk L 1011	0.663	0.578	0.883	0.589	0.502
Spk H 1011	6.941	5.435	5.863	5.815	5.493
6011	<0.244	<0.108	<0.052	0.021	<0.140

Note: mcg/g = microgram/gram

TABLE B-17. RANGE PERCENT AS AN ESTIMATE OF PRECISION ON DUPLICATE DETERMINATIONS

Range Percent as an Estimate of Precision on Duplicate Determinations[a]

Sample ID	Cr205.552 Range %	Cu324.754 Range %	Zn213.856 Range %	Hg184.949 Range %	Be313.042 Range %	Ag328.068 Range %	Tl190.864 Range %	As193.759 Range %	Ba455.403 Range %
1001	28.73	12.06	0.21	NA	23.32	16.05	NA	NA	13.75
1005	8.60	8.53	6.15	NA	20.44	25.21	NA	NA	4.93
1007	1.04	69.34	6.26	NA	NA	56.79	6.40	NA	9.70
1009	20.56	0.47	9.98	NA	15.38	13.13	9.80	NA	79.08
1011	4.02	0.67	11.16	NA	0.00	31.58	18.53	NA	1.57

NA = Not Applicable because the sample conc. (mcg/g) and/or the duplicate conc. (mcg/g) were below detection limit.

a. Range Percent = $$\frac{\text{The Absolute Value of the Sample Conc. (mcg/g) Less the Duplicate Conc. (mcg/g)}}{\text{Mean of the Sample and Duplicate Concentrations (mcg/g)}} \times 100$$

TABLE B-17 (Continued)

Range Percent as an Estimate of Precision on Duplicate Determinations[a]

Sample ID	Se196.090 Range %	Sb206.833 Range %	Ni231.604 Range %	Cd214.438 Range %	Pb220.353 Range %
1001	NA	NA	NA	42.22	NA
1005	NA	NA	NA	4.57	NA
1007	NA	NA	NA	4.42	NA
1009	NA	NA	14.58	3.75	NA
1011	NA	NA	1.15	2.90	NA

NA = Not Applicable because the sample conc. (mcg/g) and/or the duplicate conc. (mcg/g) were below detection limit.

a. Range Percent = $$\frac{\text{The Absolute Value of the Sample Conc. (mcg/g) Less the Duplicate Conc. (mcg/g)}}{\text{Mean of the Sample and Duplicate Concentrations (mcg/g)}} \times 100$$

TABLE B-18. PERCENT RECOVERIES ON SPIKE DETERMINATION

Sample ID	Cr205.552 Percent Recovery	Cu324.754 Percent Recovery	Zn213.856 Percent Recovery	Hg184.949 Percent Recovery	Be313.042 Percent Recovery	Ag328.068 Percent Recovery	Tl190.864 Percent Recovery	As193.759 Percent Recovery	Ba455.403 Percent Recovery
Spk L 1001	113.39	107.40	113.94	95.46	107.53	88.07	115.48	51.51	103.23
Spk H 1001	96.07	89.26	94.05	104.88	92.41	109.46	89.60	104.02	106.96
Spk L 1005	112.69	101.65	164.22	78.75	108.16	101.87	58.04	60.18	101.42
Spk H 1005	92.41	85.98	104.38	103.38	91.28	98.21	68.05	107.97	103.30
Spk L 1007	113.05	19.10	87.75	81.13	109.91	86.17	79.03	48.23	101.81
Spk H 1007	86.23	41.91	67.12	103.79	83.44	103.16	74.22	103.45	104.95
Spk L 1009	116.76	108.75	124.18	91.72	104.59	104.88	70.80	71.10	139.54
Spk H 1009	98.03	87.30	97.27	105.74	87.23	118.80	81.88	105.96	102.30
Spk L 1011	102.88	94.66	65.02	82.99	102.31	89.88	40.35	57.56	92.94
Spk H 1011	106.67	96.21	103.77	103.73	107.15	71.49	92.66	104.58	96.19

a. If the unspiked sample was below tne detection limit then the detection limit was used in the percent recovery calculation.

$$\text{Percent Recovery} = \frac{\text{Conc. in Spike (mcg/g)} - \text{Conc. in Unspiked (mcg/g)}}{\text{Amount Spiked (mcg/g)}} \text{ X } 100$$

TABLE B-18 (Continued)

Sample ID	Se196.090 Percent Recovery	Sb206.833 Percent Recovery	Ni231.604 Percent Recovery	Cd214.438 Percent Recovery	Pb220.353 Percent Recovery
Spk L 1001	84.81	96.36	94.52	108.80	83.19
Spk H 1001	60.27	107.80	108.86	94.32	82.68
Spk L 1005	45.02	89.87	102.85	112.26	102.25
Spk H 1005	81.00	103.76	107.17	91.34	88.63
Spk L 1007	54.59	95.97	92.55	111.34	80.83
Spk H 1007	56.81	108.67	106.96	84.07	74.64
Spk L 1009	86.86	53.33	115.70	106.79	81.18
Spk H 1009	64.47	76.55	110.14	89.46	79.66
Spk L 1011	77.06	88.35	102.88	105.94	67.50
Spk H 1011	122.85	97.81	101.47	106.29	98.27

a. If the unspiked sample was below the detection limit then the detection limit was used in the percent recovery calculation.

$$\text{Percent Recovery} = \frac{\text{Conc. in Spike (mcg/g)} - \text{Conc. in Unspiked (mcg/g)}}{\text{Amount Spiked (mcg/g)}} \times 100$$

SCRUBBER WATER ANALYSIS DATA

TABLE B-19. PRIORITY POLLUTANT CONCENTRATIONS IN SCRUBBER WATERS

	Concentration (ng/mL)[a]					
Constituent	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6
Scrubber Makeup						
Methylene chloride	1.4	3.7	1.4	0.9	0.002	0.1
Chloroform	51.7	53.3	60.4	58.6	0.3	7.5
1,2-Dichloroethane	0.3	0.3	0.06	0.2	ND[b]	ND
1,1,1-Trichloroethane	0.06	0.8	0.2	ND	ND	ND
Bromodichloromethane	13.5	13.2	15.5	15.8	0.06	1.8
Dibromochloromethane	2.0	1.7	1.9	2.2	ND	ND
Benzene	0.1	0.6	0.1	0.02	0.04	0.01
2-Chloroethyl vinyl ether	0.2	0.2	0.05	0.1	0.2	ND
1,1,2,2-Trichloroethane	0.02	ND	0.02	ND	ND	ND
Tetrachloroethylene	0.1	0.2	0.2	ND	0.05	ND
Toluene	0.1	0.3	0.2	0.2	0.1	0.2
Ethylbenzene	0.05	0.02	0.09	ND	ND	ND
Scrubber discharge						
Methylene chloride	6.3	2.3	1.1	0.2	0.8	0.4
Chloroform	2.3	1.7	1.9	1.7	0.1	0.3
1,2-Dichloroethane	0.2	0.04	ND	ND	ND	ND
Bromodichloromethane	0.6	3.4	0.4	0.5	ND	0.1
Benzene	0.5	21.7	0.2	0.03	0.1	0.1
2-chloroethyl vinyl ether	0.3	0.07	0.2	0.5	ND	ND
Tetrachloroethylene	0.1	0.3	0.03	ND	ND	ND
Toluene	0.3	0.1	0.2	0.07	0.3	0.4
Ethylbenzene	0.04	0.1	0.04	0.07	0.1	0.1

[a] Based on MRI analyses.

[b] ND = Not detected.

CHLORIDE DATA

Raw data for chlorides is in terms of concentrations (mg/L) found in the MM5 impinger train. Multiplying concentration by the volume collected (mL) in the impinger results in a chlorine value (mg) found in the impinger. Both the first (condensate) and fourth (Na_2CO_3) impingers are used for chloride analysis, making the total chloride present equal to their sum.

Division of total chlorine by MM5 sample volume results in stack chloride concentration (mg/dscf). This allows multiplication by the stack flow rate (dscfm), which gives a chloride emission rate (mg/m). Conversion to appropriate units (lb/hr) is then performed.

HCl efficiency is determined from the HCl emissions and the total chloride feedrate. Total chloride feedrate for the sum is calculated through multiplying each constituent's waste feedrate (polyethylene wax, liquid organic, etc.) by its chlorine content (Table B-12, Waste Feed Characteristics). A summation of the chlorine found in each waste feed gives the total chlorine input to the incinerator. Dividing the HCl emission rate by this input rate allows determination of HCl removal efficiency.

TABLE B-20. HCl EMISSIONS

Run No.	Impinger No.	Impinger Cl (mg/L)	Impinger volume (mL)	Cl in impinger (mg)	Total Cl in train (mg)	MM5 gas volume sampled (dscf)	Cl conc. (mg/dscf)	Stack flow rate (dscfm)	Cl emissions (mg/m)	Cl emission (lb/hr)	Cl emission (kg/hr)
1A	1	2.41	628.5	1.515							
	4	3.21	106.7	0.343	1.857	73.376	0.03	13,209	334	0.0441	0.020
1B	1	2.63	670.7	1.764							
	4	1.36	104.4	0.142	1.906	68.657	0.03	14,184	394	0.0521	0.024
2A	1	1.95	567.6	1.107							
	4	4.88	93.2	0.455	1.562	74.532	0.02	13,070	274	0.0362	0.016
2B	1	1.91	595.2	1.137							
	4	3.08	107.2	0.330	1.467	73.520	0.02	13,725	274	0.0362	0.016
3A	1	1.58	518.0	0.818							
	4	2.9	107.1	0.311	1.129	68.005	0.02	14,038	233	0.0308	0.014
3B	1	2.21	536.7	1.186							
	4	3.79	101.8	0.386	1.572	73.313	0.02	14,163	304	0.0402	0.018
4A	1	2.97	726.2	2.157							
	4	4.56	16.1	0.073	2.230	75.939	0.03	14,547	427	0.0564	0.026
4B	1	3	682.2	2.047							
	4	6.05	102.1	0.618	2.664	83.676	0.03	15,419	491	0.0649	0.030
5A	1	2.8	746.7	2.091							
	4	2.78	104.2	0.290	2.380	84.683	0.03	15,025	422	0.0558	0.025
5B	1	3.48	791.2	2.753							
	4	3.42	103.3	0.353	3.107	83.933	0.04	15,519	574	0.0759	0.035
6A	1	3.86	803.6	3.102							
	4	5.1	99.5	0.507	3.609	88.632	0.04	14,727	600	0.0793	0.036
6B	1	4.19	822.5	3.446							
	4	4.81	101.0	0.486	3.932	85.683	0.05	14,806	679	0.0897	0.040

TABLE B-21. HCl EFFICIENCY

Run	Average emission rate (kg/hr)	Total chlorine feedrate (kg/hr)	Efficiency (%)
1	0.022	338.49	99.993
2	0.016	152.70	99.989
3	0.016	163.96	99.990
4	0.028	130.33	99.978
5	0.030	214.01	99.985
6	0.038	238.67	99.984

PARTICULATE AND STACK DATA

TABLE B-22. MM5 TRAIN UTILIZATION

Train	Particulates	Semivolatiles
1-A		X
1-B	X	
2-A	X	
2-B		X
3-A	X	
3-B		X
4-A		X
4-B	X	
5-A		X
5-B	X	
6-A		X
6-B	X	

TABLE B-23. MM5 PARTICULATE DATA

```
FILE NAME - TME1A                                              PROG.=VER 01/06/87 V1
RUN # - 1-A                                                    01-06-1987  15:43:10
LOCATION - TME
DATE - 12-8-86
PROJECT # - 8671-L-1

Initial Meter Volume (Cubic Feet)=                 586.000
Final Meter Volume (Cubic Feet)=                   641.370
Meter Factor=                                        0.989
Multiple leak checks, see end of printout                     Leak Correction=  0.0000
Net Meter Volume (Cubic Feet)=                      54.761
Gas Volume (Dry Standard Cubic Feet)=               53.586

Barometric Pressure (in Hg)=                         30.05
Static Pressure (Inches H20)=                        -0.38

Percent Oxygen=                                        9.5
Percent Carbon Dioxide=                                8.3
Moisture Collected (ml)=                             571.2
Percent Water=                                        30.5    **Saturated Stack**

Average Meter Temperature (F)=                          83
Average Delta H (in H20)=                             0.68
Average Delta P (in H20)=                            0.215
Average Stack Temperature (F)=                         158

Dry Molecular Weight=                                29.71
Wet Molecular Weight=                                26.14

Average Square Root of Delta P (in H20)=            0.4608
% Isokinetic=                                        100.1

Pitot Coefficient=                                    0.84
Sampling Time (Minutes)=                             120.0
Nozzle Diameter (Inches)=                            0.279
Stack Axis #1 (Inches)=                               48.0
Stack Axis #2 (Inches)=                               48.0
Circular Stack
Stack Area (Square Feet)=                            12.57

Stack Velocity  (Actual, Feet/min)=                  1,764
Flow Rate (Actual, Cubic ft/min)=                   22,163
Flow rate (Standard, Wet, Cubic ft/min)=            19,007
Flow Rate (Standard, Dry, Cubic ft/min)=            13,209

Particulate Loading - Front Half

Particulate Weight (g)=                             0.0000       Corr. to 7% O2
Particulate Loading, Dry Std. (gr/scf)=             0.0000      0.0000
Particulate Loading, Actual (gr/cu ft)=             0.0000
Emission Rate (lb/hr)=                                0.00

No Back Half Analysis
```

TABLE B-23 (Continued)

```
                        * * METRIC UNITS * *
FILE NAME - TME1A                                         PROG.=VER 01/06/87 V1
RUN # - 1-A                                               01-06-1987  15:43:12
LOCATION - TME
DATE - 12-8-86
PROJECT # - 8671-L-1

Initial Meter Volume (Cubic Meters)=           16.593
Final Meter Volume (Cubic Meters)=             18.161
Meter Factor=                                   0.989
Multiple leak checks, see end of printout             Leak Correction=  0.0000
Net Meter Volume (Cubic Meters)=                1.551
Gas Volume (Dry Standard Cubic Meters)=         1.517

Barometric Pressure (mm Hg)=                      763
Static Pressure (mm H2O)=                         -10

Percent Oxygen=                                   9.5
Percent Carbon Dioxide=                           8.3
Moisture Collected (ml)=                        571.2
Percent Water=                                   30.5  **Saturated Stack**

Average Meter Temperature (C)=                     28
Average Delta H (mm H2O)=                        17.2
Average Delta P (mm H2O)=                         5.5
Average Stack Temperature (C)=                     70

Dry Molecular Weight=                           29.71
Wet Molecular Weight=                           26.14

Average Square Root of Delta P (mm H2O)=       2.3225
% Isokinetic=                                   100.1

Pitot Coefficient=                               0.84
Sampling Time (Minutes)=                        120.0
Nozzle Diameter (mm)=                            7.09
Stack Axis #1 (Meters)=                         1.219
Stack Axis #2 (Meters)=                         1.219
Circular Stack
Stack Area (Square Meters)=                     1.167

Stack Velocity  (Actual, m/min)=                  538
Flow rate (Actual, Cubic m/min)=                  628
Flow rate (Standard, Wet, Cubic m/min)=           538
Flow rate (Standard, Dry, Cubic m/min)=           374

Particulate Loading - Front Half

Particulate Weight (g)=                           0.0      Corr. to 7% O2
Particulate Loading, Dry Std. (mg/cu m)=          0.0        0.0
Particulate Loading, Actual (mg/cu m)=            0.0
Emission Rate (kg/hr)=                           0.00

No Back Half Analysis
```

TABLE B-23 (Continued)

```
FILE NAME - TME1A                                        PROG.=VER 01/06/87 V1
RUN # - 1-A                                              01-06-1987  15:43:14
LOCATION - TME
DATE - 12-8-86
PROJECT # - 8671-L-1

Point #        Delta P    Delta H    Stack T      Meter T
              (in. H2O)  (in. H2O)    (F)      In(F)   Out(F)
  1            0.200       0.60       160        78      78
  2            0.170       0.53       158        80      78
  3            0.190       0.61       157        81      78
  4            0.180       0.58       156        82      78
  5            0.200       0.65       156        84      78
  6            0.280       0.91       156        84      78
  7            0.210       0.70       156        84      79
  8            0.200       0.65       156        86      80
  9            0.230       0.75       156        88      80
 10            0.250       0.82       156        88      80
 11            0.160       0.52       156        88      81
 12            0.140       0.46       156        86      81
 13            0.240       0.72       160        80      78
 14            0.220       0.66       160        80      80
 15            0.240       0.74       159        84      80
 16            0.300       0.95       158        86      80
 17            0.280       0.90       158        90      80
 18            0.260       0.81       159        91      80
 19            0.200       0.65       158        90      80
 20            0.260       0.79       160        88      82
 21            0.230       0.70       160        88      82
 22            0.190       0.60       159        88      82
 23            0.130       0.40       158        88      82
 24            0.190       0.57       159        86      82


Fraction                 Final Wt.  Tare Wt.  Blank Wt.  Net Wt.
                            (g)        (g)       (g)       (g)
DRY CATCH                 0.0000     0.0000    0.0000    0.0000
FILTER                    0.0000     0.0000    0.0000    0.0000

Fraction                 Final Wt.  Tare Wt.    Vol.     Net Wt.
                            (g)        (g)      (ml)       (g)
PROBE RINSE               0.0000     0.0000     0.0     0.0000
IMPINGERS                 0.0000     0.0000     0.0     0.0000
Probe Rinse Blank (mg/ml)=  0.0000
Impinger Blank (mg/ml)=  0.0000

Multiple leak checks used.  Final readings for each segment are listed below

Lk Rate (cfm) Time (min)
     0.0020    60.0000
     0.0030    60.0000
```

TABLE B-23 (Continued)

```
FILE NAME - TME1B                                         PROG.=VER 01/06/87 V1
RUN # - 1B                                                01-07-1986  17:17:22
LOCATION - TME
DATE - 12-8-86
PROJECT # - 8671-L-1

Initial Meter Volume (Cubic Feet)=             821.800
Final Meter Volume (Cubic Feet)=               884.510
Meter Factor=                                    0.970
Multiple leak checks, see end of printout                Leak Correction=  0.0000
Net Meter Volume (Cubic Feet)=                  60.829
Gas Volume (Dry Standard Cubic Feet)=           59.215

Barometric Pressure (in Hg)=                     30.05
Static Pressure (Inches H20)=                    -0.38

Percent Oxygen=                                    9.5
Percent Carbon Dioxide=                            8.3
Moisture Collected (ml)=                         605.6
Percent Water=                                    26.4  **Saturated Stack**

Average Meter Temperature (F)=                      86
Average Delta H (in H20)=                         0.79
Average Delta P (in H20)=                        0.225
Average Stack Temperature (F)=                     152

Dry Molecular Weight=                            29.71
Wet Molecular Weight=                            26.62

Average Square Root of Delta P (in H20)=        0.4709
% Isokinetic=                                    100.1

Pitot Coefficient=                                0.84
Sampling Time (Minutes)=                         120.0
Nozzle Diameter (Inches)=                        0.283
Stack Axis #1 (Inches)=                           48.0
Stack Axis #2 (Inches)=                           48.0
Circular Stack
Stack Area (Square Feet)=                        12.57

Stack Velocity  (Actual, Feet/min)=              1,771
Flow Rate (Actual, Cubic ft/min)=               22,253
Flow rate (Standard, Wet, Cubic ft/min)=        19,269
Flow Rate (Standard, Dry, Cubic ft/min)=        14,184

Particulate Loading - Front Half

Particulate Weight (g)=                         0.0219      Corr. to 7% O2
Particulate Loading, Dry Std. (gr/scf)=         0.0057     0.0069
Particulate Loading, Actual (gr/cu ft)=         0.0036
Emission Rate (lb/hr)=                            0.69

No Back Half Analysis
```

TABLE B-23 (Continued)

```
                         * * METRIC UNITS * *
FILE NAME - TME1B                                      PROG.=VER 01/06/87 V1
RUN # - 1B                                             01-07-1986  17:17:24
LOCATION - TME
DATE - 12-8-86
PROJECT # - 8671-L-1

Initial Meter Volume (Cubic Meters)=           23.270
Final Meter Volume (Cubic Meters)=             25.046
Meter Factor=                                   0.970
Multiple leak checks, see end of printout              Leak Correction=  0.0000
Net Meter Volume (Cubic Meters)=                1.722
Gas Volume (Dry Standard Cubic Meters)=         1.677

Barometric Pressure (mm Hg)=                      763
Static Pressure (mm H2O)=                         -10

Percent Oxygen=                                   9.5
Percent Carbon Dioxide=                           8.3
Moisture Collected (ml)=                        605.6
Percent Water=                                   26.4  **Saturated Stack**

Average Meter Temperature (C)=                     30
Average Delta H (mm H2O)=                        20.2
Average Delta P (mm H2O)=                         5.7
Average Stack Temperature (C)=                     67

Dry Molecular Weight=                           29.71
Wet Molecular Weight=                           26.62

Average Square Root of Delta P (mm H2O)=       2.3731
% Isokinetic=                                   100.1

Pitot Coefficient=                               0.84
Sampling Time (Minutes)=                        120.0
Nozzle Diameter (mm)=                            7.19
Stack Axis #1 (Meters)=                         1.219
Stack Axis #2 (Meters)=                         1.219
Circular Stack
Stack Area (Square Meters)=                     1.167

Stack Velocity  (Actual, m/min)=                  540
Flow rate (Actual, Cubic m/min)=                  630
Flow rate (Standard, Wet, Cubic m/min)=           546
Flow rate (Standard, Dry, Cubic m/min)=           402

Particulate Loading - Front Half

Particulate Weight (g)=                           0.0      Corr. to 7% O2
Particulate Loading, Dry Std. (mg/cu m)=         13.1       15.9
Particulate Loading, Actual (mg/cu m)=            8.3
Emission Rate (kg/hr)=                           0.31

No Back Half Analysis
```

TABLE B-23 (Continued)

```
FILE NAME - TME1B                                     PROG.=VER 01/06/87 V1
RUN # - 1B                                            01-07-1986  17:17:26
LOCATION - TME
DATE - 12-8-86
PROJECT # - 8671-L-1

Point #      Delta P    Delta H    Stack T     Meter T
            (in. H20)  (in. H20)    (F)     In(F)  Out(F)
 1           0.150       0.53       153       74      75
 2           0.130       0.43       151       76      76
 3           0.150       0.50       150       79      76
 4           0.150       0.57       149       81      77
 5           0.220       0.77       150       84      78
 6           0.280       1.03       150       86      79
 7           0.230       0.85       150       88      80
 8           0.230       0.85       150       89      81
 9           0.250       0.90       150       92      82
 10          0.240       0.90       150       93      84
 11          0.220       0.82       150       94      85
 12          0.220       0.80       150       94      85
 13          0.150       0.48       155       80      80
 14          0.150       0.49       153       81      82
 15          0.270       0.93       152       84      82
 16          0.230       0.84       152       89      82
 17          0.240       0.79       152       93      83
 18          0.250       0.89       152       95      84
 19          0.320       1.15       152       96      85
 20          0.280       0.96       155       97      85
 21          0.250       0.90       154       98      86
 22          0.250       0.89       155       99      86
 23          0.220       0.72       154      100      87
 24          0.320       1.05       155       99      87


Fraction                 Final Wt.  Tare Wt.  Blank Wt.  Net Wt.
                            (g)        (g)       (g)        (g)
DRY CATCH                 0.0000     0.0000    0.0000     0.0000
FILTER                    4.1264     4.1094    0.0012     0.0158

Fraction                 Final Wt.  Tare Wt.    Vol.      Net Wt.
                            (g)        (g)       (ml)       (g)
PROBE RINSE              68.1042    68.0978    315.0     0.0061
IMPINGERS                 0.0000     0.0000      0.0     0.0000
Probe Rinse Blank (mg/ml)=  0.0010
Impinger Blank (mg/ml)=  0.0010

Multiple leak checks used.  Final readings for each segment are listed below

Lk Rate (cfm) Time (min)
    0.0020    60.0000
    0.0030    60.0000
```

TABLE B-23 (Continued)

```
FILE NAME - TME2A                                         PROG.=VER 01/06/87 V1
RUN # - 2A                                                01-05-1987  16:12:34
LOCATION - TME
DATE - 12-9-86
PROJECT # - 8671-L-1

Initial Meter Volume (Cubic Feet)=              641.800
Final Meter Volume (Cubic Feet)=                695.960
Meter Factor=                                     0.989
Multiple leak checks, see end of printout                 Leak Correction=  0.0000
Net Meter Volume (Cubic Feet)=                   53.564
Gas Volume (Dry Standard Cubic Feet)=            52.749

Barometric Pressure (in Hg)=                      29.95
Static Pressure (Inches H2O)=                     -0.38

Percent Oxygen=                                     9.7
Percent Carbon Dioxide=                             7.7
Moisture Collected (ml)=                          503.0
Percent Water=                                     27.8  **Saturated Stack**

Average Meter Temperature (F)=                       77
Average Delta H (in H2O)=                          0.66
Average Delta P (in H2O)=                         0.196
Average Stack Temperature (F)=                      154

Dry Molecular Weight=                             29.62
Wet Molecular Weight=                             26.39

Average Square Root of Delta P (in H2O)=         0.4404
% Isokinetic=                                      99.6

Pitot Coefficient=                                 0.84
Sampling Time (Minutes)=                          120.0
Nozzle Diameter (Inches)=                         0.279
Stack Axis #1 (Inches)=                            48.0
Stack Axis #2 (Inches)=                            48.0
Circular Stack
Stack Area (Square Feet)=                         12.57

Stack Velocity  (Actual, Feet/min)=               1,675
Flow Rate (Actual, Cubic ft/min)=                21,045
FLOW RATE (Standard, Wet, Cubic ft/min)=         18,104
Flow Rate (Standard, Dry, Cubic ft/min)=         13,070

Particulate Loading - Front Half

Particulate Weight (g)=                          0.0172      Corr. to 7% O2
Particulate Loading, Dry Std. (gr/scf)=          0.0050     0.0062
Particulate Loading, Actual (gr/cu ft)=          0.0031
Emission Rate (lb/hr)=                             0.56

No Back Half Analysis
```

TABLE B-23 (Continued)

```
                          * * METRIC UNITS * *
FILE NAME - TME2A                                      PROG.=VER 01/06/87 V1
RUN # - 2A                                             01-05-1987  16:12:37
LOCATION - TME
DATE - 12-9-86
PROJECT # - 8671-L-1

Initial Meter Volume (Cubic Meters)=          18.173
Final Meter Volume (Cubic Meters)=            19.707
Meter Factor=                                  0.989
Multiple leak checks, see end of printout            Leak Correction=  0.0000
Net Meter Volume (Cubic Meters)=               1.517
Gas Volume (Dry Standard Cubic Meters)=        1.494

Barometric Pressure (mm Hg)=                     761
Static Pressure (mm H2O)=                        -10

Percent Oxygen=                                  9.7
Percent Carbon Dioxide=                          7.7
Moisture Collected (ml)=                       503.0
Percent Water=                                  27.8  **Saturated Stack**

Average Meter Temperature (C)=                    25
Average Delta H (mm H2O)=                       16.9
Average Delta P (mm H2O)=                        5.0
Average Stack Temperature (C)=                    68

Dry Molecular Weight=                          29.62
Wet Molecular Weight=                          26.39

Average Square Root of Delta P (mm H2O)=      2.2193
% Isokinetic=                                   99.6

Pitot Coefficient=                              0.84
Sampling Time (Minutes)=                       120.0
Nozzle Diameter (mm)=                           7.09
Stack Axis #1 (Meters)=                        1.219
Stack Axis #2 (Meters)=                        1.219
Circular Stack
Stack Area (Square Meters)=                    1.167

Stack Velocity  (Actual, m/min)=                 510
FLOW RATE (Actual, Cubic m/min)=                 596
FLOW RATE (Standard, Wet, Cubic m/min)=          513
FLOW RATE (Standard, Dry, Cubic m/min)=          370

Particulate Loading - Front Half

Particulate Weight (g)=                          0.0      Corr. to 7% O2
Particulate Loading, Dry Std. (mg/cu m)=        11.5       14.2
Particulate Loading, Actual (mg/cu m)=           7.1
Emission Rate (kg/hr)=                          0.25

No Back Half Analysis
```

TABLE B-23 (Continued)

```
FILE NAME - TME2A                                        PROG.=VER 01/06/87 V1
RUN # - 2A                                               01-05-1987  16:12:39
LOCATION - TME
DATE - 12-9-86
PROJECT # - 8671-L-1

Point #       Delta P   Delta H    Stack T      Meter T
             (in. H2O) (in. H2O)    (F)     In(F)  Out(F)
 1            0.160      0.54       153       76      76
 2            0.150      0.51       153       78      76
 3            0.180      0.62       153       82      76
 4            0.240      0.83       153       86      78
 5            0.200      0.70       153       88      79
 6            0.210      0.75       153       90      80
 7            0.190      0.65       154       90      80
 8            0.200      0.70       154       89      80
 9            0.210      0.71       154       90      80
 10           0.180      0.65       153       91      81
 11           0.120      0.42       153       92      83
 12           0.120      0.42       152       91      83
 13           0.200      0.70       152       72      72
 14           0.220      0.76       152       72      72
 15           0.240      0.81       153       72      72
 16           0.230      0.77       154       74      72
 17           0.230      0.76       154       74      71
 18           0.260      0.85       156       74      70
 19           0.240      0.80       155       76      69
 20           0.230      0.80       154       76      68
 21           0.180      0.57       156       74      68
 22           0.190      0.61       156       72      68
 23           0.180      0.57       156       72      68
 24           0.140      0.44       156       72      68


Fraction                 Final Wt.  Tare Wt.  Blank Wt.  Net Wt.
                           (g)        (g)        (g)       (g)
DRY CATCH                0.0000     0.0000     0.0000    0.0000
FILTER                   3.9714     3.9592     0.0012    0.0110

Fraction                 Final Wt.  Tare Wt.    Vol.     Net Wt.
                           (g)        (g)       (ml)      (g)
PROBE RINSE             67.6054    67.5990     244.5    0.0062
IMPINGERS                0.0000     0.0000       0.0    0.0000
Probe Rinse Blank (mg/ml)=  0.0010
Impinger Blank (mg/ml)=  0.0010

Multiple leak checks used.  Final readings for each segment are listed below

Lk Rate (cfm) Time (min)
    0.0010    60.0000
    0.0050    60.0000
```

TABLE B-23 (Continued)

```
FILE NAME - TME2B                                       PROG.=VER 01/06/87 V1
RUN # - 2B                                              01-07-1986  14:31:42
LOCATION - TME
DATE - 12-9-86
PROJECT # - 8671-L-1

Initial Meter Volume (Cubic Feet)=            885.000
Final Meter Volume (Cubic Feet)=              944.350
Meter Factor=                                   0.970
Multiple leak checks, see end of printout              Leak Correction=  0.0000
Net Meter Volume (Cubic Feet)=                 57.569
Gas Volume (Dry Standard Cubic Feet)=          56.998

Barometric Pressure (in Hg)=                    29.95
Static Pressure (Inches H2O)=                   -0.38

Percent Oxygen=                                   9.7
Percent Carbon Dioxide=                           7.7
Moisture Collected (ml)=                        533.7
Percent Water=                                   26.1  **Saturated Stack**

Average Meter Temperature (F)=                     75
Average Delta H (in H2O)=                        0.71
Average Delta P (in H2O)=                       0.210
Average Stack Temperature (F)=                    151

Dry Molecular Weight=                           29.62
Wet Molecular Weight=                           26.59

Average Square Root of Delta P (in H2O)=       0.4540
% Isokinetic=                                    99.6

Pitot Coefficient=                               0.84
Sampling Time (Minutes)=                        120.0
Nozzle Diameter (Inches)=                       0.283
Stack Axis #1 (Inches)=                          48.0
Stack Axis #2 (Inches)=                          48.0
Circular Stack
Stack Area (Square Feet)=                       12.57

Stack Velocity  (Actual, Feet/min)=             1,710
Flow Rate (Actual, Cubic ft/min)=              21,490
Flow rate (Standard, Wet, Cubic ft/min)=       18,566
Flow Rate (Standard, Dry, Cubic ft/min)=       13,725

Particulate Loading - Front Half

Particulate Weight (g)=                        0.0000     Corr. to 7% O2
Particulate Loading, Dry Std. (gr/scf)=        0.0000    0.0000
Particulate Loading, Actual (gr/cu ft)=        0.0000
Emission Rate (lb/hr)=                           0.00

No Back Half Analysis
```

TABLE B-23 (Continued)

```
                          * * METRIC UNITS * *
FILE NAME - TME2B                                    PROG.=VER 01/06/87 V1
RUN # - 2B                                           01-07-1986  14:31:44
LOCATION - TME
DATE - 12-9-86
PROJECT # - 8671-L-1

Initial Meter Volume (Cubic Meters)=         25.060
Final Meter Volume (Cubic Meters)=           26.740
Meter Factor=                                 0.970
Multiple leak checks, see end of printout            Leak Correction=  0.0000
Net Meter Volume (Cubic Meters)=              1.630
Gas Volume (Dry Standard Cubic Meters)=       1.614

Barometric Pressure (mm Hg)=                    761
Static Pressure (mm H2O)=                       -10

Percent Oxygen=                                 9.7
Percent Carbon Dioxide=                         7.7
Moisture Collected (ml)=                      533.7
Percent Water=                                 26.1  **Saturated Stack**

Average Meter Temperature (C)=                   24
Average Delta H (mm H2O)=                      17.9
Average Delta P (mm H2O)=                       5.3
Average Stack Temperature (C)=                   66

Dry Molecular Weight=                         29.62
Wet Molecular Weight=                         26.59

Average Square Root of Delta P (mm H2O)=     2.2879
% Isokinetic=                                  99.6

Pitot Coefficient=                             0.84
Sampling Time (Minutes)=                      120.0
Nozzle Diameter (mm)=                          7.19
Stack Axis #1 (Meters)=                       1.219
Stack Axis #2 (Meters)=                       1.219
Circular Stack
Stack Area (Square Meters)=                   1.167

Stack Velocity  (Actual, m/min)=                521
Flow rate (Actual, Cubic m/min)=                609
Flow rate (Standard, Wet, Cubic m/min)=         526
Flow rate (Standard, Dry, Cubic m/min)=         389

Particulate Loading - Front Half

Particulate Weight (g)=                         0.0      Corr. to 7% O2
Particulate Loading, Dry Std. (mg/cu m)=        0.0        0.0
Particulate Loading, Actual (mg/cu m)=          0.0
Emission Rate (kg/hr)=                         0.00

No Back Half Analysis
```

TABLE B-23 (Continued)

```
FILE NAME - TME2B                                          PROG.=VER 01/06/87 V1
RUN # - 2B                                                 01-07-1986  14:31:46
LOCATION - TME
DATE - 12-9-86
PROJECT # - 8671-L-1

Point #         Delta P    Delta H    Stack T      Meter T
               (in. H2O)  (in. H2O)     (F)     In(F)  Out(F)
 1               0.100       0.34       150       73      74
 2               0.100       0.33       149       74      74
 3               0.200       0.69       149       76      75
 4               0.190       0.67       150       79      75
 5               0.180       0.64       150       80      77
 6               0.180       0.63       150       79      77
 7               0.290       1.02       150       78      77
 8               0.280       1.01       150       79      77
 9               0.210       0.75       150       80      77
 10              0.210       0.75       149       80      78
 11              0.200       0.70       150       80      78
 12              0.180       0.62       150       80      78
 13              0.150       0.52       149       70      70
 14              0.180       0.60       150       68      72
 15              0.190       0.63       150       70      71
 16              0.210       0.68       152       71      70
 17              0.280       0.94       151       72      70
 18              0.320       1.03       154       74      70
 19              0.240       0.79       152       76      71
 20              0.240       0.80       152       76      71
 21              0.220       0.70       156       74      71
 22              0.260       0.80       156       73      70
 23              0.220       0.67       156       74      70
 24              0.200       0.63       154       77      72



Fraction                 Final Wt. Tare Wt. Blank Wt. Net Wt.
                            (g)       (g)      (g)      (g)
DRY CATCH               0.0000    0.0000    0.0000    0.0000
FILTER                  0.0000    0.0000    0.0000    0.0000

Fraction                 Final Wt. Tare Wt.   Vol.     Net Wt.
                            (g)       (g)     (ml)      (g)
PROBE RINSE             0.0000    0.0000     0.0    0.0000
IMPINGERS               0.0000    0.0000     0.0    0.0000
Probe Rinse Blank (mg/ml)=  0.0000
Impinger Blank (mg/ml)=  0.0000

Multiple leak checks used.  Final readings for each segment are listed below

Lk Rate (cfm) Time (min)
     0.0040   60.0000
     0.0030   60.0000
```

TABLE B-23 (Continued)

```
FILE NAME - TME3A                                    PROG.=VER 01/06/87 V1
RUN # - 3A                                           01-06-1987  13:44:04
LOCATION - TME
DATE - 12-10-86
PROJECT # - 8671-L-1

Initial Meter Volume (Cubic Feet)=             696.600
Final Meter Volume (Cubic Feet)=               752.280
Meter Factor=                                    0.989
Multiple leak checks, see end of printout              Leak Correction=  0.0000
Net Meter Volume (Cubic Feet)=                  55.068
Gas Volume (Dry Standard Cubic Feet)=           56.299

Barometric Pressure (in Hg)=                     30.05
Static Pressure (Inches H2O)=                    -0.38

Percent Oxygen=                                   10.1
Percent Carbon Dioxide=                            7.4
Moisture Collected (ml)=                         442.9
Percent Water=                                    24.1  **Saturated Stack**

Average Meter Temperature (F)=                      59
Average Delta H (in H2O)=                         0.74
Average Delta P (in H2O)=                        0.205
Average Stack Temperature (F)=                     148

Dry Molecular Weight=                            29.59
Wet Molecular Weight=                            26.80

Average Square Root of Delta P (in H2O)=        0.4504
% Isokinetic=                                     98.9

Pitot Coefficient=                                0.84
Sampling Time (Minutes)=                         120.0
Nozzle Diameter (Inches)=                        0.279
Stack Axis #1 (Inches)=                           48.0
Stack Axis #2 (Inches)=                           48.0
Circular Stack
Stack Area (Square Feet)=                        12.57

Stack Velocity  (Actual, Feet/min)=              1,689
Flow Rate (Actual, Cubic ft/min)=               21,222
Flow rate (Standard, Wet, Cubic ft/min)=        18,489
Flow Rate (Standard, Dry, Cubic ft/min)=        14,038

Particulate Loading - Front Half

Particulate Weight (g)=                         0.0111     Corr. to 7% O2
Particulate Loading, Dry Std. (gr/scf)=         0.0030    0.0039
Particulate Loading, Actual (gr/cu ft)=         0.0020
Emission Rate (lb/hr)=                            0.37

No Back Half Analysis
```

TABLE B-23 (Continued)

```
                                    * * METRIC UNITS * *
FILE NAME - TME3A                                                  PROG.=VER 01/06/87 V1
RUN # - 3A                                                         01-06-1987  13:44:06
LOCATION - TME
DATE - 12-10-86
PROJECT # - 8671-L-1

Initial Meter Volume (Cubic Meters)=          19.725
Final Meter Volume (Cubic Meters)=            21.302
Meter Factor=                                  0.989
Multiple leak checks, see end of printout              Leak Correction=  0.0000
Net Meter Volume (Cubic Meters)=               1.559
Gas Volume (Dry Standard Cubic Meters)=        1.594

Barometric Pressure (mm Hg)=                     763
Static Pressure (mm H2O)=                        -10

Percent Oxygen=                                 10.1
Percent Carbon Dioxide=                          7.4
Moisture Collected (ml)=                       442.9
Percent Water=                                  24.1   **Saturated Stack**

Average Meter Temperature (C)=                    15
Average Delta H (mm H2O)=                       18.7
Average Delta P (mm H2O)=                        5.2
Average Stack Temperature (C)=                    65

Dry Molecular Weight=                          29.59
Wet Molecular Weight=                          26.80

Average Square Root of Delta P (mm H2O)=      2.2697
% Isokinetic=                                   98.9

Pitot Coefficient=                              0.84
Sampling Time (Minutes)=                       120.0
Nozzle Diameter (mm)=                           7.09
Stack Axis #1 (Meters)=                        1.219
Stack Axis #2 (Meters)=                        1.219
Circular Stack
Stack Area (Square Meters)=                    1.167

Stack Velocity  (Actual, m/min)=                 515
Flow rate (Actual, Cubic m/min)=                 601
Flow rate (Standard, Wet, Cubic m/min)=          524
Flow rate (Standard, Dry, Cubic m/min)=          398

Particulate Loading - Front Half

Particulate Weight (g)=                          0.0       Corr. to 7% O2
Particulate Loading, Dry Std. (mg/cu m)=         7.0         9.0
Particulate Loading, Actual (mg/cu m)=           4.6
Emission Rate (kg/hr)=                          0.17

No Back Half Analysis
```

TABLE B-23 (Continued)

```
FILE NAME - TME3A                                          PROG.=VER 01/06/87 V1
RUN # - 3A                                                 01-06-1987  13:44:08
LOCATION - TME
DATE - 12-10-86
PROJECT # - 8671-L-1

Point #      Delta P    Delta H    Stack T     Meter T
            (in. H20) (in. H20)    (F)      In(F)  Out(F)
  1          0.150       0.53      148        50      50
  2          0.150       0.53      150        52      50
  3          0.210       0.72      150        58      50
  4          0.200       0.70      149        62      51
  5          0.210       0.75      148        68      51
  6          0.210       0.75      148        70      52
  7          0.230       0.82      148        60      60
  8          0.240       0.86      148        63      60
  9          0.230       0.80      150        66      60
  10         0.230       0.83      148        66      60
  11         0.140       0.51      147        66      60
  12         0.150       0.55      147        66      60
  13         0.220       0.77      149        54      54
  14         0.200       0.70      149        58      54
  15         0.250       0.85      151        58      55
  16         0.260       0.95      150        62      56
  17         0.240       0.86      148        62      56
  18         0.250       0.91      147        64      58
  19         0.240       0.90      147        66      60
  20         0.230       0.90      146        66      60
  21         0.180       0.66      147        66      60
  22         0.170       0.62      147        64      60
  23         0.150       0.55      147        64      60
  24         0.170       0.63      146        64      60


Fraction                 Final Wt.  Tare Wt.  Blank Wt.  Net Wt.
                            (g)        (g)        (g)       (g)
DRY CATCH                 0.0000     0.0000     0.0000    0.0000
FILTER                    4.1688     4.1597     0.0012    0.0079

Fraction                 Final Wt.  Tare Wt.    Vol.     Net Wt.
                            (g)        (g)      (ml)       (g)
PROBE RINSE              76.8949    76.8914    250.0    0.0032
IMPINGERS                 0.0000     0.0000      0.0    0.0000
Probe Rinse Blank (mg/ml)=  0.0010
Impinger Blank (mg/ml)=  0.0010

Multiple leak checks used.  Final readings for each segment are listed below

Lk Rate (cfm) Time (min)
    0.0030    32.0000
    0.0020    28.0000
    0.0040    60.0000
```

TABLE B-23 (Continued)

```
FILE NAME - TME3B                                                PROG.=VER 01/06/87 V1
RUN # - 3B                                                       01-07-1986  14:33:59
LOCATION - TME
DATE - 12-10-86
PROJECT # - 8671-L-1

Initial Meter Volume (Cubic Feet)=                 944.800
Final Meter Volume (Cubic Feet)=                  1003.940
Meter Factor=                                        0.970
Multiple leak checks, see end of printout                    Leak Correction=  0.0000
Net Meter Volume (Cubic Feet)=                      57.366
Gas Volume (Dry Standard Cubic Feet)=               58.888

Barometric Pressure (in Hg)=                         30.05
Static Pressure (Inches H2O)=                        -0.38

Percent Oxygen=                                       10.1
Percent Carbon Dioxide=                                7.4
Moisture Collected (ml)=                             487.6
Percent Water=                                        23.4   **Saturated Stack**

Average Meter Temperature (F)=                          57
Average Delta H (in H2O)=                             0.72
Average Delta P (in H2O)=                            0.208
Average Stack Temperature (F)=                         147

Dry Molecular Weight=                                29.59
Wet Molecular Weight=                                26.88

Average Square Root of Delta P (in H2O)=            0.4521
% Isokinetic=                                         99.7

Pitot Coefficient=                                    0.84
Sampling Time (Minutes)=                             120.0
Nozzle Diameter (Inches)=                            0.283
Stack Axis #1 (Inches)=                               48.0
Stack Axis #2 (Inches)=                               48.0
Circular Stack
Stack Area (Square Feet)=                            12.57

Stack Velocity  (Actual, Feet/min)=                  1,685
Flow Rate (Actual, Cubic ft/min)=                   21,177
Flow rate (Standard, Wet, Cubic ft/min)=            18,485
Flow Rate (Standard, Dry, Cubic ft/min)=            14,163

Particulate Loading - Front Half

Particulate Weight (g)=                             0.0000       Corr. to 7% O2
Particulate Loading, Dry Std. (gr/scf)=             0.0000      0.0000
Particulate Loading, Actual (gr/cu ft)=             0.0000
Emission Rate (lb/hr)=                                0.00

No Back Half Analysis
```

TABLE B-23 (Continued)

```
                         * * METRIC UNITS * *
FILE NAME - TME3B                                        PROG.=VER 01/06/87 V1
RUN # - 3B                                               01-07-1986  14:34:01
LOCATION - TME
DATE - 12-10-86
PROJECT # - 8671-L-1

Initial Meter Volume (Cubic Meters)=        26.753
Final Meter Volume (Cubic Meters)=          28.428
Meter Factor=                                0.970
Multiple leak checks, see end of printout            Leak Correction=  0.0000
Net Meter Volume (Cubic Meters)=             1.624
Gas Volume (Dry Standard Cubic Meters)=      1.667

Barometric Pressure (mm Hg)=                   763
Static Pressure (mm H2O)=                      -10

Percent Oxygen=                               10.1
Percent Carbon Dioxide=                        7.4
Moisture Collected (ml)=                     487.6
Percent Water=                                23.4  **Saturated Stack**

Average Meter Temperature (C)=                  14
Average Delta H (mm H2O)=                     18.4
Average Delta P (mm H2O)=                      5.3
Average Stack Temperature (C)=                  64

Dry Molecular Weight=                        29.59
Wet Molecular Weight=                        26.88

Average Square Root of Delta P (mm H2O)=    2.2785
% Isokinetic=                                 99.7

Pitot Coefficient=                            0.84
Sampling Time (Minutes)=                     120.0
Nozzle Diameter (mm)=                         7.19
Stack Axis #1 (Meters)=                      1.219
Stack Axis #2 (Meters)=                      1.219
Circular Stack
Stack Area (Square Meters)=                  1.167

Stack Velocity  (Actual, m/min)=               514
Flow rate (Actual, Cubic m/min)=               600
Flow rate (Standard, Wet, Cubic m/min)=        523
Flow rate (Standard, Dry, Cubic m/min)=        401

Particulate Loading - Front Half

Particulate Weight (g)=                        0.0        Corr. to 7% O2
Particulate Loading, Dry Std. (mg/cu m)=       0.0          0.0
Particulate Loading, Actual (mg/cu m)=         0.0
Emission Rate (kg/hr)=                        0.00

No Back Half Analysis
```

TABLE B-23 (Continued)

```
FILE NAME - TME3B                                          PROG.=VER 01/06/87 V1
RUN # - 3B                                                 01-07-1986  14:34:03
LOCATION - TME
DATE - 12-10-86
PROJECT # - 8671-L-1

Point #       Delta P    Delta H     Stack T       Meter T
            (in. H2O)  (in. H2O)     (F)     In(F)   Out(F)
  1           0.100       0.34       145       48       49
  2           0.120       0.42       146       49       49
  3           0.150       0.52       146       52       50
  4           0.150       0.53       146       55       50
  5           0.190       0.68       146       56       52
  6           0.180       0.64       145       59       53
  7           0.240       0.84       146       54       54
  8           0.310       1.08       147       57       56
  9           0.250       0.83       150       62       56
  10          0.260       0.94       149       64       57
  11          0.250       0.86       148       66       58
  12          0.270       0.93       148       66       59
  13          0.150       0.49       148       54       54
  14          0.140       0.46       148       54       56
  15          0.220       0.72       150       57       56
  16          0.200       0.70       148       59       56
  17          0.220       0.76       147       60       57
  18          0.270       0.94       147       62       58
  19          0.260       0.91       147       63       58
  20          0.230       0.82       145       64       58
  21          0.230       0.81       146       65       58
  22          0.210       0.75       146       65       58
  23          0.200       0.70       147       65       59
  24          0.190       0.67       146       64       59



Fraction                 Final Wt.  Tare Wt.  Blank Wt.  Net Wt.
                            (g)        (g)       (g)       (g)
DRY CATCH                 0.0000     0.0000    0.0000    0.0000
FILTER                    0.0000     0.0000    0.0000    0.0000

Fraction                 Final Wt.  Tare Wt.    Vol.     Net Wt.
                            (g)        (g)      (ml)       (g)
PROBE RINSE               0.0000     0.0000     0.0    0.0000
IMPINGERS                 0.0000     0.0000     0.0    0.0000
Probe Rinse Blank (mg/ml)=  0.0000
Impinger Blank (mg/ml)=  0.0000

Multiple leak checks used.  Final readings for each segment are listed below

Lk Rate (cfm) Time (min)
     0.0030   60.0000
     0.0040   60.0000
```

TABLE B-23 (Continued)

```
FILE NAME - TME4A                                          PROG.=VER 01/06/97 V1
RUN # - 4A                                                 01-07-1986  14:37:44
LOCATION - TME
DATE - 12-11-86
PROJECT # - 8671-L-1

Initial Meter Volume (Cubic Feet)=                 753.700
Final Meter Volume (Cubic Feet)=                   812.880
Meter Factor=                                        0.989
Multiple leak checks, see end of printout                  Leak Correction=  0.0000
Net Meter Volume (Cubic Feet)=                      58.529
Gas Volume (Dry Standard Cubic Feet)=               59.137

Barometric Pressure (in Hg)=                         30.05
Static Pressure (Inches H2O)=                        -0.38

Percent Oxygen=                                        9.5
Percent Carbon Dioxide=                                8.0
Moisture Collected (ml)=                             586.4
Percent Water=                                        26.7  **Saturated Stack**

Average Meter Temperature (F)=                          66
Average Delta H (in H2O)=                             0.82
Average Delta P (in H2O)=                            0.236
Average Stack Temperature (F)=                         152

Dry Molecular Weight=                                29.66
Wet Molecular Weight=                                26.55

Average Square Root of Delta P (in H2O)=            0.4829
% Isokinetic=                                        100.3

Pitot Coefficient=                                    0.84
Sampling Time (Minutes)=                             120.0
Nozzle Diameter (Inches)=                            0.279
Stack Axis #1 (Inches)=                               48.0
Stack Axis #2 (Inches)=                               48.0
Circular Stack
Stack Area (Square Feet)=                            12.57

Stack Velocity  (Actual, Feet/min)=                  1,826
Flow Rate (Actual, Cubic ft/min)=                   22,942
Flow rate (Standard, Wet, Cubic ft/min)=            19,850
Flow Rate (Standard, Dry, Cubic ft/min)=            14,547

Particulate Loading - Front Half

Particulate Weight (g)=                             0.0000      Corr. to 7% O2
Particulate Loading, Dry Std. (gr/scf)=             0.0000     0.0000
Particulate Loading, Actual (gr/cu ft)=             0.0000
Emission Rate (lb/hr)=                                0.00

No Back Half Analysis
```

TABLE B-23 (Continued)

```
                        * * METRIC UNITS * *
FILE NAME - TME4A                                   PROG.=VER 01/06/87 V1
RUN # - 4A                                          01-07-1986  14:37:46
LOCATION - TME
DATE - 12-11-86
PROJECT # - 8671-L-1

Initial Meter Volume (Cubic Meters)=          21.342
Final Meter Volume (Cubic Meters)=            23.018
Meter Factor=                                  0.989
Multiple leak checks, see end of printout             Leak Correction=  0.0000
Net Meter Volume (Cubic Meters)=               1.657
Gas Volume (Dry Standard Cubic Meters)=        1.675

Barometric Pressure (mm Hg)=                     763
Static Pressure (mm H2O)=                        -10

Percent Oxygen=                                  9.5
Percent Carbon Dioxide=                          8.0
Moisture Collected (ml)=                       586.4
Percent Water=                                  26.7  **Saturated Stack**

Average Meter Temperature (C)=                    19
Average Delta H (mm H2O)=                       20.9
Average Delta P (mm H2O)=                        6.0
Average Stack Temperature (C)=                    67

Dry Molecular Weight=                          29.66
Wet Molecular Weight=                          26.55

Average Square Root of Delta P (mm H2O)=      2.4336
% Isokinetic=                                  100.3

Pitot Coefficient=                              0.84
Sampling Time (Minutes)=                       120.0
Nozzle Diameter (mm)=                           7.09
Stack Axis #1 (Meters)=                        1.219
Stack Axis #2 (Meters)=                        1.219
Circular Stack
Stack Area (Square Meters)=                    1.167

Stack Velocity  (Actual, m/min)=                 556
Flow rate (Actual, Cubic m/min)=                 650
Flow rate (Standard, Wet, Cubic m/min)=          562
Flow rate (Standard, Dry, Cubic m/min)=          412

Particulate Loading - Front Half

Particulate Weight (g)=                          0.0        Corr. to 7% O2
Particulate Loading, Dry Std. (mg/cu m)=         0.0         0.0
Particulate Loading, Actual (mg/cu m)=           0.0
Emission Rate (kg/hr)=                          0.00

No Back Half Analysis
```

TABLE B-23 (Continued)

```
FILE NAME - TME4A                                      PROG.=VER 01/06/87 V1
RUN # - 4A                                             01-07-1986  14:37:48
LOCATION - TME
DATE - 12-11-86
PROJECT # - 8671-L-1

Point #         Delta P    Delta H    Stack T       Meter T
               (in. H20)  (in. H20)    (F)      In(F)  Out(F)
 1               0.190      0.66       148        44     44
 2               0.200      0.65       152        48     44
 3               0.220      0.72       152        54     45
 4               0.220      0.72       153        58     46
 5               0.250      0.83       153        64     46
 6               0.270      0.90       153        66     48
 7               0.250      0.85       152        72     52
 8               0.260      0.90       152        74     54
 9               0.260      0.90       152        76     56
 10              0.250      0.85       154        76     58
 11              0.170      0.60       153        78     58
 12              0.160      0.55       152        78     60
 13              0.250      0.85       152        62     60
 14              0.260      0.90       153        67     60
 15              0.280      0.95       153        74     62
 16              0.290      1.00       154        79     62
 17              0.290      1.10       153        82     62
 18              0.280      1.10       152        84     64
 19              0.270      1.00       152        85     65
 20              0.320      1.20       152        86     66
 21              0.240      0.82       153        88     68
 22              0.200      0.70       152        89     69
 23              0.140      0.50       152        90     70
 24              0.140      0.50       152        88     72


Fraction                  Final Wt.  Tare Wt.  Blank Wt.  Net Wt.
                             (g)        (g)       (g)        (g)
DRY CATCH                 0.0000     0.0000     0.0000     0.0000
FILTER                    0.0000     0.0000     0.0000     0.0000

Fraction                  Final Wt.  Tare Wt.    Vol.     Net Wt.
                             (g)        (g)      (ml)       (g)
PROBE RINSE               0.0000     0.0000     0.0      0.0000
IMPINGERS                 0.0000     0.0000     0.0      0.0000
Probe Rinse Blank (mg/ml)=  0.0000
Impinger Blank (mg/ml)=  0.0000

Multiple leak checks used.  Final readings for each segment are listed below

Lk Rate (cfm) Time (min)
    0.0020    60.0000
    0.0010    60.0000
```

TABLE B-23 (Continued)

```
FILE NAME - TME4B                                        PROG.=VER 01/06/87 V1
RUN # - 4B                                               01-07-1986  14:36:04
LOCATION - TME
DATE - 12-11-86
PROJECT # - 8671-L-1

Initial Meter Volume (Cubic Feet)=              4.650
Final Meter Volume (Cubic Feet)=               70.180
Meter Factor=                                   0.970
Multiple leak checks, see end of printout              Leak Correction=  0.0000
Net Meter Volume (Cubic Feet)=                 63.564
Gas Volume (Dry Standard Cubic Feet)=          64.360

Barometric Pressure (in Hg)=                    30.05
Static Pressure (Inches H20)=                   -0.38

Percent Oxygen=                                   9.5
Percent Carbon Dioxide=                           8.0
Moisture Collected (ml)=                        625.2
Percent Water=                                   25.1  **Saturated Stack**

Average Meter Temperature (F)=                     65
Average Delta H (in H20)=                        0.89
Average Delta P (in H20)=                       0.256
Average Stack Temperature (F)=                    150

Dry Molecular Weight=                           29.66
Wet Molecular Weight=                           26.73

Average Square Root of Delta P (in H20)=       0.5033
% Isokinetic=                                   100.1

Pitot Coefficient=                               0.84
Sampling Time (Minutes)=                        120.0
Nozzle Diameter (Inches)=                       0.283
Stack Axis #1 (Inches)=                          48.0
Stack Axis #2 (Inches)=                          48.0
Circular Stack
Stack Area (Square Feet)=                       12.57

Stack Velocity  (Actual, Feet/min)=             1,885
Flow Rate (Actual, Cubic ft/min)=              23,692
Flow rate (Standard, Wet, Cubic ft/min)=       20,584
Flow Rate (Standard, Dry, Cubic ft/min)=       15,419

Particulate Loading - Front Half

Particulate Weight (g)=                        0.0166     Corr. to 7% O2
Particulate Loading, Dry Std. (gr/scf)=        0.0040    0.0048
Particulate Loading, Actual (gr/cu ft)=        0.0026
Emission Rate (lb/hr)=                           0.53

No Back Half Analysis
```

TABLE B-23 (Continued)

```
                                    * * METRIC UNITS * *
FILE NAME - TME4B                                                 PROG.=VER 01/06/87 V1
RUN # - 4B                                                        01-07-1986  14:36:06
LOCATION - TME
DATE - 12-11-86
PROJECT # - 8671-L-1

Initial Meter Volume (Cubic Meters)=              0.132
Final Meter Volume (Cubic Meters)=                1.987
Meter Factor=                                     0.970
Multiple leak checks, see end of printout                  Leak Correction=  0.0000
Net Meter Volume (Cubic Meters)=                  1.800
Gas Volume (Dry Standard Cubic Meters)=           1.822

Barometric Pressure (mm Hg)=                        763
Static Pressure (mm H20)=                           -10

Percent Oxygen=                                     9.5
Percent Carbon Dioxide=                             8.0
Moisture Collected (ml)=                          625.2
Percent Water=                                     25.1    **Saturated Stack**

Average Meter Temperature (C)=                       18
Average Delta H (mm H20)=                          22.5
Average Delta P (mm H20)=                           6.5
Average Stack Temperature (C)=                       65

Dry Molecular Weight=                             29.66
Wet Molecular Weight=                             26.73

Average Square Root of Delta P (mm H20)=         2.5364
% Isokinetic=                                     100.1

Pitot Coefficient=                                 0.84
Sampling Time (Minutes)=                          120.0
Nozzle Diameter (mm)=                              7.19
Stack Axis #1 (Meters)=                           1.219
Stack Axis #2 (Meters)=                           1.219
Circular Stack
Stack Area (Square Meters)=                       1.167

Stack Velocity  (Actual, m/min)=                    575
Flow rate (Actual, Cubic m/min)=                    671
Flow rate (Standard, Wet, Cubic m/min)=             583
Flow rate (Standard, Dry, Cubic m/min)=             437

Particulate Loading - Front Half

Particulate Weight (g)=                             0.0         Corr. to 7% 02
Particulate Loading, Dry Std. (mg/cu m)=            9.1          11.1
Particulate Loading, Actual (mg/cu m)=              5.9
Emission Rate (kg/hr)=                             0.24

No Back Half Analysis
```

TABLE B-23 (Continued)

```
FILE NAME - TME4B                                      PROG.=VER 01/06/87 V1
RUN # - 4B                                             01-07-1986  14:36:08
LOCATION - TME
DATE - 12-11-86
PROJECT # - 8671-L-1

Point #        Delta P    Delta H    Stack T      Meter T
              (in. H20)  (in. H20)    (F)     In(F)  Out(F)
  1             0.160      0.52       148       43      45
  2             0.130      0.41       148       44      45
  3             0.220      0.74       148       47      45
  4             0.240      0.80       150       52      46
  5             0.220      0.73       150       56      48
  6             0.250      0.87       148       60      50
  7             0.300      1.05       148       64      52
  8             0.320      1.10       150       68      54
  9             0.270      0.93       150       70      57
  10            0.290      1.00       151       72      59
  11            0.250      0.87       150       73      60
  12            0.260      0.91       150       76      62
  13            0.210      0.70       150       62      62
  14            0.210      0.73       150       63      63
  15            0.290      1.00       151       69      64
  16            0.320      1.10       152       74      64
  17            0.280      0.98       151       78      66
  18            0.290      1.03       150       81      67
  19            0.340      1.22       150       82      68
  20            0.300      1.08       150       85      70
  21            0.270      0.96       150       86      70
  22            0.240      0.85       150       88      72
  23            0.250      0.86       150       88      72
  24            0.230      0.85       150       89      73



Fraction                 Final Wt.  Tare Wt.  Blank Wt.  Net Wt.
                           (g)        (g)        (g)       (g)
DRY CATCH                0.0000     0.0000     0.0000    0.0000
FILTER                   3.9907     3.9764     0.0012    0.0131

Fraction                 Final Wt.  Tare Wt.    Vol.     Net Wt.
                           (g)        (g)       (ml)      (g)
PROBE RINSE             66.9890    66.9852    250.0     0.0035
IMPINGERS                0.0000     0.0000      0.0     0.0000
Probe Rinse Blank (mg/ml)=  0.0010
Impinger Blank (mg/ml)=  0.0010

Multiple leak checks used.  Final readings for each segment are listed below

Lk Rate (cfm) Time (min)
    0.0030   60.0000
    0.0020   60.0000
```

TABLE B-23 (Continued)

```
FILE NAME - TME5A                                              PROG.=VER 01/06/87 V1
RUN # - 5A                                                     01-07-1986  14:39:29
LOCATION - TME
DATE - 12-12-86
PROJECT # - 8671-L-1

Initial Meter Volume (Cubic Feet)=                 813.700
Final Meter Volume (Cubic Feet)=                   874.580
Meter Factor=                                        0.989
Multiple leak checks, see end of printout                     Leak Correction=  0.0000
Net Meter Volume (Cubic Feet)=                      60.210
Gas Volume (Dry Standard Cubic Feet)=               60.706

Barometric Pressure (in Hg)=                         30.23
Static Pressure (Inches H2O)=                        -0.38

Percent Oxygen=                                       10.1
Percent Carbon Dioxide=                                7.0
Moisture Collected (ml)=                             687.0
Percent Water=                                        30.9    **Saturated Stack**

Average Meter Temperature (F)=                          70
Average Delta H (in H2O)=                             0.87
Average Delta P (in H2O)=                            0.276
Average Stack Temperature (F)=                         159

Dry Molecular Weight=                                29.52
Wet Molecular Weight=                                25.96

Average Square Root of Delta P (in H2O)=            0.5245
% Isokinetic=                                         99.7

Pitot Coefficient=                                    0.84
Sampling Time (Minutes)=                             120.0
Nozzle Diameter (Inches)=                            0.279
Stack Axis #1 (Inches)=                               48.0
Stack Axis #2 (Inches)=                               48.0
Circular Stack
Stack Area (Square Feet)=                            12.57

Stack Velocity  (Actual, Feet/min)=                  2,009
Flow Rate (Actual, Cubic ft/min)=                   25,251
Flow rate (Standard, Wet, Cubic ft/min)=            21,755
Flow Rate (Standard, Dry, Cubic ft/min)=            15,025

Particulate Loading - Front Half

Particulate Weight (g)=                             0.0000       Corr. to 7% O2
Particulate Loading, Dry Std. (gr/scf)=             0.0000      0.0000
Particulate Loading, Actual (gr/cu ft)=             0.0000
Emission Rate (lb/hr)=                                0.00

No Back Half Analysis
```

TABLE B-23 (Continued)

```
                        * * METRIC UNITS * *
FILE NAME - TME5A                                        PROG.=VER 01/06/87 V1
RUN # - 5A                                               01-07-1986  14:39:31
LOCATION - TME
DATE - 12-12-86
PROJECT # - 8671-L-1

Initial Meter Volume (Cubic Meters)=             23.041
Final Meter Volume (Cubic Meters)=               24.765
Meter Factor=                                     0.989
Multiple leak checks, see end of printout              Leak Correction=  0.0000
Net Meter Volume (Cubic Meters)=                  1.705
Gas Volume (Dry Standard Cubic Meters)=           1.719

Barometric Pressure (mm Hg)=                        768
Static Pressure (mm H2O)=                           -10

Percent Oxygen=                                    10.1
Percent Carbon Dioxide=                             7.0
Moisture Collected (ml)=                          687.0
Percent Water=                                     30.9    **Saturated Stack**

Average Meter Temperature (C)=                       21
Average Delta H (mm H2O)=                          22.1
Average Delta P (mm H2O)=                           7.0
Average Stack Temperature (C)=                       70

Dry Molecular Weight=                             29.52
Wet Molecular Weight=                             25.96

Average Square Root of Delta P (mm H2O)=         2.6432
% Isokinetic=                                      99.7

Pitot Coefficient=                                 0.84
Sampling Time (Minutes)=                          120.0
Nozzle Diameter (mm)=                              7.09
Stack Axis #1 (Meters)=                           1.219
Stack Axis #2 (Meters)=                           1.219
Circular Stack
Stack Area (Square Meters)=                       1.167

Stack Velocity  (Actual, m/min)=                    612
Flow rate (Actual, Cubic m/min)=                    715
Flow rate (Standard, Wet, Cubic m/min)=             616
Flow rate (Standard, Dry, Cubic m/min)=             425

Particulate Loading - Front Half

Particulate Weight (g)=                             0.0        Corr. to 7% O2
Particulate Loading, Dry Std. (mg/cu m)=            0.0          0.0
Particulate Loading, Actual (mg/cu m)=              0.0
Emission Rate (kg/hr)=                             0.00

No Back Half Analysis
```

TABLE B-23 (Continued)

```
FILE NAME - TME5A                                    PROG.=VER 01/06/87 V1
RUN # - 5A                                           01-07-1986  14:39:33
LOCATION - TME
DATE - 12-12-86
PROJECT # - 8671-L-1

Point #       Delta P    Delta H     Stack T      Meter T
             (in. H20)  (in. H20)     (F)      In(F)   Out(F)
  1            0.220      0.63        160        52      50
  2            0.240      0.69        160        54      50
  3            0.280      0.80        161        58      50
  4            0.270      0.80        159        64      52
  5            0.290      0.85        160        70      54
  6            0.300      0.90        159        74      56
  7            0.320      1.10        159        76      58
  8            0.320      1.00        158        80      60
  9            0.280      0.87        158        81      62
  10           0.280      0.89        158        82      63
  11           0.260      0.83        157        84      66
  12           0.260      0.83        158        84      66
  13           0.250      0.78        157        64      62
  14           0.270      0.85        157        68      63
  15           0.280      0.90        157        72      64
  16           0.290      0.92        157        80      64
  17           0.330      1.10        157        82      65
  18           0.310      1.10        157        85      66
  19           0.310      1.10        158        88      68
  20           0.320      1.10        159        90      70
  21           0.260      0.79        160        93      73
  22           0.290      0.87        161        92      74
  23           0.210      0.64        160        92      74
  24           0.190      0.58        160        91      75


Fraction                 Final Wt.  Tare Wt.  Blank Wt.  Net Wt.
                           (g)        (g)       (g)        (g)
DRY CATCH               0.0000     0.0000    0.0000     0.0000
FILTER                  0.0000     0.0000    0.0000     0.0000

Fraction                 Final Wt.  Tare Wt.    Vol.     Net Wt.
                           (g)        (g)       (ml)       (g)
PROBE RINSE             0.0000     0.0000      0.0     0.0000
IMPINGERS               0.0000     0.0000      0.0     0.0000
Probe Rinse Blank (mg/ml)=  0.0000
Impinger Blank (mg/ml)=  0.0000

Multiple leak checks used.  Final readings for each segment are listed below

Lk Rate (cfm) Time (min)
    0.0010    60.0000
    0.0020    60.0000
```

TABLE B-23 (Continued)

```
FILE NAME - TME5B                                          PROG.=VER 01/06/87 V1
RUN # - 5B                                                 01-06-1987  15:03:33
LOCATION - TME
DATE - 12-12-86
PROJECT # - 8671-L-1

Initial Meter Volume (Cubic Feet)=               70.900
Final Meter Volume (Cubic Feet)=                136.537
Meter Factor=                                     0.970
Multiple leak checks, see end of printout               Leak Correction=  0.0000
Net Meter Volume (Cubic Feet)=                   63.668
Gas Volume (Dry Standard Cubic Feet)=            64.884

Barometric Pressure (in Hg)=                      30.23
Static Pressure (Inches H20)=                     -0.38

Percent Oxygen=                                    10.1
Percent Carbon Dioxide=                             7.0
Moisture Collected (ml)=                          736.2
Percent Water=                                     28.9  **Saturated Stack**

Average Meter Temperature (F)=                       64
Average Delta H (in H20)=                          0.89
Average Delta P (in H20)=                         0.283
Average Stack Temperature (F)=                      156

Dry Molecular Weight=                             29.52
Wet Molecular Weight=                             26.20

Average Square Root of Delta P (in H20)=         0.5290
% Isokinetic=                                     100.2

Pitot Coefficient=                                 0.84
Sampling Time (Minutes)=                          120.0
Nozzle Diameter (Inches)=                         0.283
Stack Axis #1 (Inches)=                            48.0
Stack Axis #2 (Inches)=                            48.0
Circular Stack
Stack Area (Square Feet)=                         12.57

Stack Velocity  (Actual, Feet/min)=               2,006
Flow Rate (Actual, Cubic ft/min)=                25,203
Flow rate (Standard, Wet, Cubic ft/min)=         21,815
Flow Rate (Standard, Dry, Cubic ft/min)=         15,519

Particulate Loading - Front Half

Particulate Weight (g)=                          0.0337     Corr. to 7% O2
Particulate Loading, Dry Std. (gr/scf)=          0.0080    0.0103
Particulate Loading, Actual (gr/cu ft)=          0.0049
Emission Rate (lb/hr)=                             1.06

No Back Half Analysis
```

TABLE B-23 (Continued)

```
                           * * METRIC UNITS * *
FILE NAME - TME5B                                          PROG.=VER 01/06/87 V1
RUN # - 5B                                                 01-06-1987  15:03:35
LOCATION - TME
DATE - 12-12-86
PROJECT # - 8671-L-1

Initial Meter Volume (Cubic Meters)=            2.008
Final Meter Volume (Cubic Meters)=              3.866
Meter Factor=                                   0.970
Multiple leak checks, see end of printout              Leak Correction=  0.0000
Net Meter Volume (Cubic Meters)=                1.803
Gas Volume (Dry Standard Cubic Meters)=         1.837

Barometric Pressure (mm Hg)=                      768
Static Pressure (mm H20)=                         -10

Percent Oxygen=                                  10.1
Percent Carbon Dioxide=                           7.0
Moisture Collected (ml)=                        736.2
Percent Water=                                   28.9  **Saturated Stack**

Average Meter Temperature (C)=                     18
Average Delta H (mm H20)=                        22.7
Average Delta P (mm H20)=                         7.2
Average Stack Temperature (C)=                     69

Dry Molecular Weight=                           29.52
Wet Molecular Weight=                           26.20

Average Square Root of Delta P (mm H20)=       2.6659
% Isokinetic=                                   100.2

Pitot Coefficient=                               0.84
Sampling Time (Minutes)=                        120.0
Nozzle Diameter (mm)=                            7.19
Stack Axis #1 (Meters)=                         1.219
Stack Axis #2 (Meters)=                         1.219
Circular Stack
Stack Area (Square Meters)=                     1.167

Stack Velocity  (Actual, m/min)=                  611
Flow rate (Actual, Cubic m/min)=                  714
Flow rate (Standard, Wet, Cubic m/min)=           618
Flow rate (Standard, Dry, Cubic m/min)=           439

Particulate Loading - Front Half

Particulate Weight (g)=                           0.0      Corr. to 7% O2
Particulate Loading, Dry Std. (mg/cu m)=         18.3       23.6
Particulate Loading, Actual (mg/cu m)=           11.3
Emission Rate (kg/hr)=                           0.48

No Back Half Analysis
```

TABLE B-23 (Continued)

```
FILE NAME - TME5B                                        PROG.=VER 01/06/87 V1
RUN # - 5B                                               01-06-1987  15:03:37
LOCATION - TME
DATE - 12-12-86
PROJECT # - 8671-L-1

Point #      Delta P    Delta H     Stack T       Meter T
            (in. H2O)  (in. H2O)     (F)      In(F)  Out(F)
  1           0.180       0.55        156        48      50
  2           0.170       0.49        157        49      49
  3           0.240       0.76        156        52      50
  4           0.220       0.68        156        56      50
  5           0.320       0.98        158        60      52
  6           0.320       0.95        156        64      54
  7           0.310       0.97        156        66      56
  8           0.310       0.97        156        68      58
  9           0.370       1.10        159        69      60
  10          0.350       1.15        154        70      61
  11          0.280       0.96        153        72      62
  12          0.270       0.92        154        73      64
  13          0.180       0.60        152        58      60
  14          0.220       0.70        152        60      62
  15          0.330       1.00        154        63      62
  16          0.280       0.94        153        69      63
  17          0.310       1.04        153        72      64
  18          0.320       1.04        155        74      65
  19          0.380       1.19        156        77      66
  20          0.330       1.05        157        80      68
  21          0.280       0.91        158        83      70
  22          0.300       0.93        158        83      71
  23          0.240       0.71        159        82      72
  24          0.280       0.82        160        81      73


Fraction                 Final Wt.  Tare Wt.  Blank Wt.  Net Wt.
                            (g)        (g)        (g)       (g)
DRY CATCH                 0.0000     0.0000     0.0000    0.0000
FILTER                    4.0204     3.9881     0.0012    0.0311

Fraction                 Final Wt.  Tare Wt.    Vol.     Net Wt.
                            (g)        (g)      (ml)       (g)
PROBE RINSE              75.8888    75.8859    293.5    0.0026
IMPINGERS                 0.0000     0.0000      0.0    0.0000
Probe Rinse Blank (mg/ml)=  0.0010
Impinger Blank (mg/ml)=  0.0010

Multiple leak checks used.  Final readings for each segment are listed below

Lk Rate (cfm) Time (min)
    0.0040    60.0000
    0.0030    60.0000
```

TABLE B-23 (Continued)

```
FILE NAME - TME6A                                                   PROG.=VER 01/06/87 V1
RUN # - 6A                                                          01-07-1986  14:41:12
LOCATION - TME
DATE - 12-13-86
PROJECT # - 8671-L-1

Initial Meter Volume (Cubic Feet)=           875.300
Final Meter Volume (Cubic Feet)=             934.100
Meter Factor=                                  0.989
Multiple leak checks, see end of printout              Leak Correction=  0.0000
Net Meter Volume (Cubic Feet)=                58.153
Gas Volume (Dry Standard Cubic Feet)=         59.708

Barometric Pressure (in Hg)=                   30.45
Static Pressure (Inches H2O)=                  -0.38

Percent Oxygen=                                 10.0
Percent Carbon Dioxide=                          7.2
Moisture Collected (ml)=                       746.4
Percent Water=                                  32.5   **Saturated Stack**

Average Meter Temperature (F)=                    64
Average Delta H (in H2O)=                       0.81
Average Delta P (in H2O)=                      0.277
Average Stack Temperature (F)=                   161

Dry Molecular Weight=                          29.55
Wet Molecular Weight=                          25.80

Average Square Root of Delta P (in H2O)=      0.5234
% Isokinetic=                                  100.0

Pitot Coefficient=                              0.84
Sampling Time (Minutes)=                       120.0
Nozzle Diameter (Inches)=                      0.279
Stack Axis #1 (Inches)=                         48.0
Stack Axis #2 (Inches)=                         48.0
Circular Stack
Stack Area (Square Feet)=                      12.57

Stack Velocity  (Actual, Feet/min)=            2,008
Flow Rate (Actual, Cubic ft/min)=             25,237
Flow rate (Standard, Wet, Cubic ft/min)=      21,818
Flow Rate (Standard, Dry, Cubic ft/min)=      14,727

Particulate Loading - Front Half

Particulate Weight (g)=                       0.0000        Corr. to 7% O2
Particulate Loading, Dry Std. (gr/scf)=       0.0000       0.0000
Particulate Loading, Actual (gr/cu ft)=       0.0000
Emission Rate (lb/hr)=                          0.00

No Back Half Analysis
```

TABLE B-23 (Continued)

```
                              * * METRIC UNITS * *
FILE NAME - TME6A                                                PROG.=VER 01/06/87 V1
RUN # - 6A                                                       01-07-1986  14:41:14
LOCATION - TME
DATE - 12-13-86
PROJECT # - 8671-L-1

Initial Meter Volume (Cubic Meters)=              24.785
Final Meter Volume (Cubic Meters)=                26.450
Meter Factor=                                      0.989
Multiple leak checks, see end of printout                  Leak Correction=  0.0000
Net Meter Volume (Cubic Meters)=                   1.647
Gas Volume (Dry Standard Cubic Meters)=            1.691

Barometric Pressure (mm Hg)=                        773
Static Pressure (mm H2O)=                           -10

Percent Oxygen=                                    10.0
Percent Carbon Dioxide=                             7.2
Moisture Collected (ml)=                          746.4
Percent Water=                                     32.5    **Saturated Stack**

Average Meter Temperature (C)=                       18
Average Delta H (mm H2O)=                          20.5
Average Delta P (mm H2O)=                           7.0
Average Stack Temperature (C)=                       72

Dry Molecular Weight=                             29.55
Wet Molecular Weight=                             25.80

Average Square Root of Delta P (mm H2O)=         2.6380
% Isokinetic=                                     100.0

Pitot Coefficient=                                 0.84
Sampling Time (Minutes)=                          120.0
Nozzle Diameter (mm)=                              7.09
Stack Axis #1 (Meters)=                           1.219
Stack Axis #2 (Meters)=                           1.219
Circular Stack
Stack Area (Square Meters)=                       1.167

Stack Velocity  (Actual, m/min)=                    612
Flow rate (Actual, Cubic m/min)=                    715
Flow rate (Standard, Wet, Cubic m/min)=             618
Flow rate (Standard, Dry, Cubic m/min)=             417

Particulate Loading - Front Half

Particulate Weight (g)=                             0.0         Corr. to 7% O2
Particulate Loading, Dry Std. (mg/cu m)=            0.0          0.0
Particulate Loading, Actual (mg/cu m)=              0.0
Emission Rate (kg/hr)=                             0.00

No Back Half Analysis
```

TABLE B-23 (Continued)

```
FILE NAME - TME6A                                         PROG.=VER 01/06/87 V1
RUN # - 6A                                                01-07-1986  14:41:16
LOCATION - TME
DATE - 12-13-86
PROJECT # - 8671-L-1

Point #       Delta P     Delta H     Stack T       Meter T
             (in. H2O)   (in. H2O)     (F)      In(F)   Out(F)
  1           0.240        0.66        162        50       50
  2           0.300        0.81        163        54       50
  3           0.280        0.76        163        58       50
  4           0.320        0.85        164        60       50
  5           0.360        1.10        162        64       52
  6           0.380        1.10        163        67       53
  7           0.320        0.90        162        70       55
  8           0.310        0.90        161        72       58
  9           0.270        0.82        159        74       60
  10          0.290        0.90        160        75       62
  11          0.230        0.70        159        76       63
  12          0.200        0.65        158        76       64
  13          0.270        0.76        162        60       58
  14          0.310        0.87        162        62       59
  15          0.310        0.90        161        68       60
  16          0.300        0.90        160        70       61
  17          0.320        0.91        162        72       62
  18          0.330        0.94        162        73       62
  19          0.280        0.80        162        76       64
  20          0.270        0.80        161        77       66
  21          0.210        0.61        161        76       66
  22          0.230        0.69        160        74       67
  23          0.180        0.56        158        74       68
  24          0.140        0.44        157        74       68



Fraction                   Final Wt.  Tare Wt.  Blank Wt.  Net Wt.
                              (g)        (g)       (g)        (g)
DRY CATCH                   0.0000     0.0000    0.0000     0.0000
FILTER                      0.0000     0.0000    0.0000     0.0000

Fraction                   Final Wt.  Tare Wt.    Vol.     Net Wt.
                              (g)        (g)      (ml)       (g)
PROBE RINSE                 0.0000     0.0000     0.0     0.0000
IMPINGERS                   0.0000     0.0000     0.0     0.0000
Probe Rinse Blank (mg/ml)=  0.0000
Impinger Blank (mg/ml)=  0.0000

Multiple leak checks used.  Final readings for each segment are listed below

Lk Rate (cfm) Time (min)
     0.0030    60.0000
     0.0020    60.0000
```

TABLE B-23 (Continued)

```
FILE NAME - TME6B                                                  PROG.=VER 01/06/87 V1
RUN # - 6B                                                         01-06-1987  15:42:17
LOCATION - TME
DATE - 12-13-86
PROJECT # - 8671-L-1

Initial Meter Volume (Cubic Feet)=                 137.100
Final Meter Volume (Cubic Feet)=                   199.337
Meter Factor=                                        0.970
Multiple leak checks, see end of printout                     Leak Correction=  0.0000
Net Meter Volume (Cubic Feet)=                      60.370
Gas Volume (Dry Standard Cubic Feet)=               62.177

Barometric Pressure (in Hg)=                        30.45
Static Pressure (Inches H2O)=                       -0.38

Percent Oxygen=                                      10.0
Percent Carbon Dioxide=                               7.2
Moisture Collected (ml)=                            769.4
Percent Water=                                       31.6    **Saturated Stack**

Average Meter Temperature (F)=                         63
Average Delta H (in H2O)=                            0.80
Average Delta P (in H2O)=                           0.275
Average Stack Temperature (F)=                        160

Dry Molecular Weight=                               29.55
Wet Molecular Weight=                               25.90

Average Square Root of Delta P (in H2O)=           0.5216
% Isokinetic=                                       100.7

Pitot Coefficient=                                   0.84
Sampling Time (Minutes)=                            120.0
Nozzle Diameter (Inches)=                           0.283
Stack Axis #1 (Inches)=                              48.0
Stack Axis #2 (Inches)=                              48.0
Circular Stack
Stack Area (Square Feet)=                           12.57

Stack Velocity  (Actual, Feet/min)=                 1,988
Flow Rate (Actual, Cubic ft/min)=                  24,983
Flow rate (Standard, Wet, Cubic ft/min)=           21,640
Flow Rate (Standard, Dry, Cubic ft/min)=           14,806

Particulate Loading - Front Half

Particulate Weight (g)=                            0.0491       Corr. to 7% O2
Particulate Loading, Dry Std. (gr/scf)=            0.0122      0.0155
Particulate Loading, Actual (gr/cu ft)=            0.0072
Emission Rate (lb/hr)=                               1.54

No Back Half Analysis
```

TABLE B-23 (Continued)

```
                         * * METRIC UNITS * *
FILE NAME - TME6B                                          PROG.=VER 01/06/87 V1
RUN # - 6B                                                 01-06-1987  15:42:19
LOCATION - TME
DATE - 12-13-86
PROJECT # - 8671-L-1

Initial Meter Volume (Cubic Meters)=             3.882
Final Meter Volume (Cubic Meters)=               5.644
Meter Factor=                                    0.970
Multiple leak checks, see end of printout                Leak Correction=  0.0000
Net Meter Volume (Cubic Meters)=                 1.709
Gas Volume (Dry Standard Cubic Meters)=          1.761

Barometric Pressure (mm Hg)=                       773
Static Pressure (mm H2O)=                          -10

Percent Oxygen=                                   10.0
Percent Carbon Dioxide=                            7.2
Moisture Collected (ml)=                         769.4
Percent Water=                                    31.6   **Saturated Stack**

Average Meter Temperature (C)=                      17
Average Delta H (mm H2O)=                         20.4
Average Delta P (mm H2O)=                          7.0
Average Stack Temperature (C)=                      71

Dry Molecular Weight=                            29.55
Wet Molecular Weight=                            25.90

Average Square Root of Delta P (mm H2O)=        2.6287
% Isokinetic=                                    100.7

Pitot Coefficient=                                0.84
Sampling Time (Minutes)=                         120.0
Nozzle Diameter (mm)=                             7.19
Stack Axis #1 (Meters)=                          1.219
Stack Axis #2 (Meters)=                          1.219
Circular Stack
Stack Area (Square Meters)=                      1.167

Stack Velocity  (Actual, m/min)=                   606
Flow rate (Actual, Cubic m/min)=                   707
Flow rate (Standard, Wet, Cubic m/min)=            613
Flow rate (Standard, Dry, Cubic m/min)=            419

Particulate Loading - Front Half

Particulate Weight (g)=                            0.0        Corr. to 7% O2
Particulate Loading, Dry Std. (mg/cu m)=          27.9         35.5
Particulate Loading, Actual (mg/cu m)=            16.5
Emission Rate (kg/hr)=                            0.70

No Back Half Analysis
```

TABLE B-23 (Continued)

```
FILE NAME - TME6B                                         PROG.=VER 01/06/87 V1
RUN # - 6B                                                01-06-1987  15:42:21
LOCATION - TME
DATE - 12-13-86
PROJECT # - 8671-L-1

Point #       Delta P    Delta H     Stack T      Meter T
            (in. H20) (in. H20)     (F)     In(F)  Out(F)
  1           0.220       0.66       157       48     49
  2           0.260       0.76       159       50     49
  3           0.160       0.47       158       54     50
  4           0.270       0.75       161       57     51
  5           0.320       0.90       160       60     52
  6           0.300       0.87       160       63     54
  7           0.330       0.94       161       65     56
  8           0.360       1.05       160       68     58
  9           0.380       1.12       160       70     60
  10          0.300       0.88       160       70     61
  11          0.250       0.78       158       71     62
  12          0.250       0.76       159       71     62
  13          0.180       0.49       163       58     59
  14          0.170       0.51       160       58     60
  15          0.260       0.77       159       62     62
  16          0.320       0.93       160       65     61
  17          0.310       0.89       161       69     62
  18          0.330       0.90       161       70     63
  19          0.300       0.89       161       72     64
  20          0.360       1.04       161       74     66
  21          0.280       0.83       160       74     67
  22          0.250       0.74       160       74     67
  23          0.250       0.77       158       74     68
  24          0.200       0.60       158       74     68


Fraction                Final Wt.  Tare Wt.  Blank Wt.  Net Wt.
                           (g)        (g)       (g)       (g)
DRY CATCH               0.0000     0.0000    0.0000     0.0000
FILTER                  4.0330     3.9888    0.0012     0.0430

Fraction                Final Wt.  Tare Wt.    Vol.     Net Wt.
                           (g)        (g)      (ml)       (g)
PROBE RINSE            76.7296    76.7232    269.0     0.0061
IMPINGERS               0.0000     0.0000      0.0     0.0000
Probe Rinse Blank (mg/ml)=  0.0010
Impinger Blank (mg/ml)=  0.0010

Multiple leak checks used.  Final readings for each segment are listed below

Lk Rate (cfm) Time (min)
    0.0010   60.0000
    0.0030   60.0000
```